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A Summary of Current Program, 10/1/66 and Preliminary Report of Progress for 10/1/65 to 9/30/66

NATURAL RESOURCE ECONOMICS DIVISION

of the

ECONOMIC RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

and related work of the

STATE AGRICULTURAL EXPERIMENT STATIONS

This progress report of USDA and cooperative research is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between October 1, 1965, and September 30, 1966. Current economic research findings are also published in the ERS publications Agricultural Economics Research, a quarterly, and The Farm Index, a monthly. This progress report was compiled in the Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C. 20250.

UNITED STATES DEPARTMENT OF AGRICULTURE

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INTRODUCTION

Natural resource economics research is focused upon economic and institutional aspects of the use, conservation, development, management, and control of natural resources; and the contribution of natural resources to regional and national economic growth.

Growing public interest and concern in natural resources is evidenced by recent legislation, study groups and advisory bodies concerned with such areas as water resources planning, water pollution abatement and improved quality, public land management, flood control, weather modification, and outdoor recreation.

The program of the Natural Resource Economics Division involves national and regional programs of research, planning assistance, and related policy assistance on natural resource problems. An integral part of the work is the participation in departmental and interagency efforts to determine high priority research needs and to formulate policies, plans, and programs for development and use of natural resources. The program is headquartered in Washington, D.C., and is carried out through four subject-matter Branches, the Resource Data Systems Group, and five Field Resource Groups concerned chiefly with regional water and related land resource planning. Close cooperation in planning and conducting work avoids duplication of efforts and provides opportunities for the direct application of research results.

Field studies generally are conducted in cooperation with State experiment stations or with Federal and State resource development agencies. Close working arrangements and cooperation with other institutions and agencies engaged in similar areas of research and in resource planning and development are essential in carrying out the program.

As a step toward implementation of the recommendations for a National Program of Research for Agriculture made jointly by the Association of State Universities and Land Grant Colleges and the USDA, a section has been added to each of the Areas in this report. It comprises a list of the related publications of the State Agricultural Experiment Stations in addition to those heretofore reported covering the results of USDA and cooperative research. In future years, it is anticipated that information will be available to permit reporting of achievements resulting from State research in a format comparable to the present reporting of the USDA and cooperative research.

Since progress was last reported, the Division has made a number of significant contributions to natural resource policies and programs. Division personnel have responded to requests from the Office of the Secretary, program administrators, the Water Resources Council, Federal Council for Science and Technology, Recreation Advisory Council, National Science Foundation, National Academy of Sciences, Bureau of the Census, and others. Division personnel participated in studies of the Federal Task Force on Federal Flood Control Policy which resulted in a report and recommendations, subsequently issued as a Congressional document (House Document No. 465, August 1966). Basic data and analyses provided by the Division continue to be utilized in understanding

the current status and changes in the development, conservation, and use of natural resources. Some examples of contributions during the reporting period follow:

Uses of Airphotos for Rural and Urban Planning. Rural and urban planning of natural resources is increasingly important. Airphotos are a valuable tool for planners and may be used in preparing land-use maps, measuring land or water areas, selecting a school site, inventorying recreation facilities, or determining changes in land use. Agriculture Handbook No. 113 describes how airphotos are made, where to obtain them, and how they may be used as an aid in preparing plans for rural and urban development.

Economics of Land Forming. Land-forming practices in 31 Eastern States were categorized and described in detail, including information describing costs and benefits of each practice. These practices include grading land for irrigation and drainage, land smoothing for drainage, and shaping hilly land for erosion and moisture control. Investments ranged from less than $10 per acre for simple smoothing to an average of about $90 per acre for land grading in western Iowa. Land-shaping costs involving "cut and fill" terraces ranged from an average of $12.51 per linear foot in Iowa to $720 per acre in the cherry orchard area of Michigan. During the period from 1955 to 1963, a half million acres were graded for drainage in the 31 Eastern States. Land leveling for irrigation in the Eastern States is currently occurring at a lower annual rate than land grading for drainage, a reversal of trends since 1955. Terracing activities are continuing at a high annual rate.

Potential Agricultural Uses of Remote Sensing from Space Platforms. Uses of aerial photography and other remote sensing techniques were reviewed and evaluated as to their potential practicality for specific applications from space altitudes. The study, which examined use of aerial photography by agencies of the Department of Agriculture, seeks to appraise potential agricultural benefits of remote sensing from space platforms. Applications judged to be feasible include inventories of major land uses, reconnaissance soil surveys, bases for mapping, survey of range conditions, and agronomic surveys. Possibly feasible applications include crop species identification, crop vigor analyses, and crop production estimates.

Recreation Facilities Operated by FHA Borrowers. A study of FHA borrowers who operated recreation enterprises found that water-based facilities for fishing, boating, and swimming were the most common recreation enterprises. Land-based facilities, including camping, hunting, picnicking, and sports, were second. Farm vacations were third and horseback riding was fourth. More than half the recreation enterprises reported were established since 1962. Roughly two-thirds of the borrowers operated only one recreation enterprise.

Special Districts for Developing Natural Resources in Appalachia. About 730 special districts for developing and managing natural resources exist in the Appalachian Region. These districts are an integral, but little understood, part of the local governmental framework. Special districts were created for a wide variety of purposes such as soil conservation, building flood control projects, providing water for domestic, agricultural, and industrial uses,

providing and operating recreation areas and other local services. About 200 functions relating to natural resources were enumerated from the enabling statutes of the 11 Appalachian States.

Feasibility of Alfalfa Processing Plants for RC&D Areas. A study was made of the feasibility of alfalfa dehydrating plants for two Resource Conservation and Development projects in Northwestern States whose sponsors were considering increased alfalfa production as one possibility for economic expansion. The resource base and capability for increased alfalfa production, market potential for dehydrated alfalfa, and plant operation were analyzed. The proposal was recommended for the Upper Willamette RC&D Project Area in Oregon where alfalfa yields and production are high and can be expanded. Installation of a dehydrating plant was not recommended for the Idaho-Washington RC&D Project Area where both production and marketing potentials were low relative to the needs of an efficiently operated dehydrating plant.

Simulation of Irrigation Operations. A simulation program developed by ERS and Harvard University economists is testing the economic effects of various water delivery rules used by irrigation organizations in distributing irrigation water to farmers. The program is designed to handle irrigation systems that have up to 40 farms, with 10 crops of 4 fields each and up to 14 irrigation periods during the season. Using information for an irrigation system, farms, crops grown, and crop response to moisture deficiency, the program simulates production through an irrigation season, taking the water forecast together with the water rights of farms, to determine which crops will yield the most return for each farm. After a season has been run, the program computes production, gross and net returns for farms and for the system. It also shows the water use on crops by farms and for the system.

Rural Zoning in the Appalachian Region. All counties are authorized to zone in 8 of the 11 Appalachian States--Georgia, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. Most North Carolina counties in the Appalachian Region may zone, but only one of 33 Alabama counties and 3 of 6 South Carolina counties in the Region may zone. Zoning ordinances for unincorporated and rural areas have actually been adopted by an estimated 17 counties in the entire Appalachian Region. In addition, some populous townships in Pennsylvania and Ohio are zoned. Wisconsin's zoning experience in the cutover counties in the 1930's provides some helpful guidelines for use of rural zoning in the Appalachian States. For instance, open-county zoning might be used for such purposes as blocking-up forest areas, guiding summer home seekers to areas where public services can be provided economically, protecting existing and potential recreation areas; avoiding unnecessary duplication of roads, and other public facilities, and guiding development of residential, commercial, and industrial areas.

Water Resource Planning Assistance. Under the general guidance of the Federal Water Resources Council, formally created by the Water Resources Planning Act of 1965, the Economic Research Service, through the Natural Resource Economics Division, cooperates with other Federal and State agencies in comprehensive long-range regional planning for development of water and related land resources. ERS responsibilities in the coordinated program concerns primarily economic

evaluation of agricultural aspects of water resource development needs and potentials, and development of basic agricultural economic intelligence for action agency programs. During the reporting period, economic studies were initiated in two major water resource regions and continued in four other regions. More detailed surveys and economic studies are being conducted in 27 individual river basins.

Federal Flood Control Policy. Executive Order 11296, "Evaluation of Flood Hazards in Locating Federally Owned or Financed Buildings, Roads, and Other Facilities, and in Disposing of Federal Lands and Properties," August 11, 1966, is a landmark in Federal flood control policy. It provides for public action in preventing uneconomic uses of flood plain land, thereby, in the long-run reducing the need for flood control. A major provision of the Order instructs Federal agencies to evaluate and consider flood hazards in programs concerned with land disposal, loans, and mortgage insurance. Actions called for by the Order are part of a broader program outlined in a Congressional Report "A Unified National Program for Managing Flood Losses" (House Document No. 465, August 1966). The report was prepared by a Task Force on Federal Flood Control Policy. Division personnel participated in the studies of the task force.

AREA NO. 1. ECONOMICS OF LAND UTILIZATION

Problem. Population growth, advances in agricultural production technology, changing consumer demands, and other factors combine to cause changing demands for the Nation's fixed supply of land. Analyses of current levels and trends in the major uses of land, of the economics of land development and conservation measures, and of land-use shifts provide the basis for informed policies and programs for land-use adjustments and the conservation and development of land resources.

USDA AND COOPERATIVE PROGRAM

Research in the economics of land utilization is divided into two subareas: (A) Inventory and Apparaisal of Land Supplies and Uses; and (B) Land Requirements, Conservation, and Development. This research provides a continuing inventory of major land uses, both farm and nonfarm, regional and national, as well as analyses of trends in type and intensity of land use by States and regions and of shifts in major agricultural uses and acreages absorbed by nonagricultural uses. The research also evaluates alternative methods for acquiring data on uses and potential of land resources and appraises the need for land conservation and development measures, the adequacy of the land-resource base for projected national agricultural output requirements and nonagricultural land needs, and resulting implications for patterns of production.

This research is both basic and applied. The nature of the research makes it necessary to draw upon several scientific disciplines; including economics, statistics, geography, soils, botany, agronomy, forestry, and photogrammetry. Research in this area is financed by directly appropriated funds and by transfer funds from the Soil Conservation Service and the National Aeronautics and Space Administration. During the reporting year, research was conducted in cooperation with the Hawaii, Arizona, and Minnesota Experiment Stations; by contract with the Purdue Research Foundation and the Systems Technology and Applied Research Corporation of Dallas, Texas; and by reimbursement agreement with the Foreign Regional Analysis Division, ERS. Informal cooperation was maintained with additional State and Federal agencies and with other organizations.

Approximately 8.4 scientist man-years were devoted to this Area during the reporting period. This included extramural research carried out under cooperative agreement and contract.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 4.6 scientist man-years were devoted to this Area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Inventory and Appraisal of Land Supplies and Uses

Maintenance of data series shows that the acreage of cropland used for crops totaled 335 million acres in 1965. The total was up only slightly from the 334 million acres used in 1964 and still near the record low of 330 million

acres used in both 1962 and 1910. Land used for crops increased over 1964 in five of the farm production regions, decreased in four regions, and remained unchanged in another. These changes ranged between 0.1 and 0.5 million acres.

An inventory of major land uses, prepared at five-year intervals, is in progress. The objective is to provide a current summary account and analysis of the extent and distribution of agricultural land use in the United States. Changes and trends in land utilization will be determined by comparison with the findings of earlier inventories in the series.

A study of urbanization of agricultural land in the North Atlantic Water Resource Region is presently underway using comparison of airphotos taken in 1950 and 1960 to identify and measure land shifting to urban uses between the population census dates. Data on the amount and type of land (land-use capability class) that has undergone urban development will be obtained from sample plots drawn for the Conservation Needs Inventory, which provides a two-percent sample of the land area of the region.

Research conducted by Purdue University under contract identifying land uses by remote sensing methods has been completed. The work is being continued and expanded by Purdue with other sources of financial support. The purposes of this research were to (1) develop specifications for imagery to identify and measure areas of vegetal species and other ground conditions that comprise land use, and (2) develop keys for identification and area measurement of land uses by image analysts. The research involved the interpretation and correlation of ground conditions with multispectral imagery of plots on the Purdue Experiment Station during the 1964 growing season. Because of tonal variations occurring within a given species, development of unique "signatures" were found to be more complex than anticipated. Factors accounting for photographic tonal variation within crop species include: (1) Variety; (2) relative maturity; (3) geometry of the crop as influenced by plant height and growth characteristics, population density, planting configuration, lodging, etc.; (4) cultural practices, such as tillage, irrigation, and certain fertilizer and spray treatments; and (5) soil type and associated characteristics such as color, texture, and moisture content of the surface soil. However, analysis of imagery shows numerous instances of the usefulness of multispectral imagery to agriculture. Soil-type mapping, particularly the determination of soil-type boundaries, could be aided substantially by a remote multispectral system capable of obtaining imagery. Usefulness of a remote-sensing system for determination of specific soil type appears limited. However, predictable spectral differences between wet and dry soils and between light and dark colored soils were found.

Research financed by the National Aeronautics and Space Administration was continued on the potential economic benefits from resource surveys from earth-orbiting satellites. A review of literature identified agricultural applications of aerial photography now operational and emerging applications which appear to have strong likelihood of success in the near future. These applications will be analyzed for potential benefits to agriculture and forestry, both in the United States and worldwide. A preliminary list of such benefits include coverage of extensive land areas, collection of information for inaccessible areas, rapid acquisition of basic data, permanency of recorded

data, and reduced cost of agricultural surveys. Research supporting the study of potential economic benefits of surveys from earth-orbiting satellites includes (1) an assessment of the current state of agricultural data collection by conventional ground methods and by conventional aerial photography for a sample of 33 countries, (2) a survey of non-Federal users of aerial photographs purchased from ASCS to determine use and the economic benefits accruing from use of these photographs, and (3) an analysis of satellite reconnaissance operational factors capable of influencing the value of agricultural data obtained and procedural specifications for acquiring statistically reliable data.

B. Land Requirements, Conservation, and Development

A land resource productivity study was initiated to develop more detailed information about agricultural land use and the present and potential productivity of the land resources. The effort will draw on information being assembled for Type I studies of the North-Atlantic, Ohio, Upper Mississippi, Missouri, and Columbia-North Pacific Water Resource Regions (See Area 9 for discussion of Type I studies). Physiographic regions--land resource areas--and soil groups by land-use capability class and subclass are the units of analysis. Estimates of present land use and productivity for selected representative counties are being provided by soil scientists and SCS work unit conservationists. Acreages of major crops grown, crop yields, and fertilizer applications will be estimated for several categories of land and water resource development--irrigated land, drained land, and land protected by flood control structures. These estimates, supplemented by other sources, will provide a basis for determining regional variations in the availability, quality, and productivity of the agricultural base in relation to future needs. Information developed will be used in the National-Interregional Analysis of Resource Development Potential (reported under Area No. 8) and, additionally, for improving methodology and data for classifying and estimating potential productivity of land.

A study of factors affecting agricultural land values in Hawaii was initiated in cooperation with the Hawaii Agricultural Experiment Station. Multiple-regression analyses will be made of the interrelationships of sale prices, leasing rates, and assessed valuations with independent variables including land quality, value of buildings and improvements, size of unit, proximity of roads and urban centers, and characteristics of sale and lease contracts. Longer-range plans involve using measured interrelationships to evaluate tenure forms and institutional devices for regulating urbanization of agricultural land.

Research was initiated in cooperation with the Minnesota Agricultural Experiment Station to analyze land use patterns resulting from the urbanization process. The study will seek to identify and measure factors associated with urbanization of rural land as a basis for evaluating alternative methods of influencing land-use change.

Cooperation was established with the Arizona Agricultural Experiment Station to study effects of a declining water supply on agricultural land use. This

is one facet of a study of the role of water in the State's economy being conducted by the University of Arizona under a grant from the Rockefeller Foundation.

Staff members representing ERS participated in the development of procedures for updating the 1958 National Inventory of Soil and Water Conservation Needs. These procedures, which include the organization and functions of State and county committees, compiling of data from the sample areas, and developing acreages of land uses and conservation treatment needs will be published in a "National Handbook for Updating the Conservation Needs Inventory" in October 1966. Working materials were prepared and technical assistance provided for a series of SCS workshops to acquaint State CNI personnel with the new procedures.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Inventory and Appraisal of Land Supplies and Uses

Changes in farm production and efficiency--a summary report. 1966. U.S. Dept. of Agriculture Statis. Bul. 233, pp. 17-19.

Supplement II to chages in farm production and efficiency--a summary report. 1966. U.S. Dept. of Agriculture Statis. Bul. 233, 7 pp.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Arnold, Adlai F., and Hottel, J.B. 1965. The Ozark region of Arkansas: Land capability, use, and ownership patterns. Ark. Farm Res. 14(3), May-June.

Geiger, Donald G., and Grey, Fenton. 1965. Land use changes in Deep Fork Valley, Oklahoma. Okla. Agr. Expt. Sta. Processed Series P-500. Dept. of Agronomy, Oklahoma State University.

Hottel, J.B., and Arnold, Adlai F. 1965. Crop, pasture, timber, and livestock enterprises for the Boston Mountain and Ozark Highland areas of Arkansas. Report Series 135.

AREA NO. 2. ECONOMICS OF WATER UTILIZATION AND WATERSHED DEVELOPMENT

Problem. For the Nation as a whole, natural water supplies are adequate to support a three- to five-fold increase in water consumption. Regionally and locally, however, full utilization of water supplies is being approached and serious temporary deficiencies due to drought frequently occur. Flood damage potentials are increasing in spite of extensive flood control programs. Agriculture is the principal consumptive use of water; thus, gains in efficiency of agricultural water use, more than in any other use, result in greater supplies for all purposes. Research is needed to provide economic intelligence by which national and regional problems of agricultural water management and development can be identified and objectively analyzed. Studies undertaken in support of this purpose are designed to provide economic facts on water supplies, uses, value, and management needs particularly as they concern agriculture; to analyze economic aspects of current water problems and identify emerging water problems; and to show the consequences of alternative solutions to water management and development problems, recognizing the interests of all concerned.

USDA AND COOPERATIVE PROGRAM

The current program can be divided into four general categories corresponding to the form of support and functions as follows: (1) Basic research, funded from regular ERS appropriations; (2) applied research, supported by transfer of funds from such agencies as the Soil Conservation Service; (3) technical assistance to ERS personnel directly involved in interagency river-basin studies, supported by transfer funds; and (4) various professional and related service activities.

About 45 percent of the program might be termed basic economic research, of which about one-sixth is extramural with land-grant universities. Applied research accounts for 45 percent of the total program, with some allotments to land-grant universities for facilities and miscellaneous consulting services. The remaining 10 percent of the funds and manpower resources are devoted to technical assistance for river-basin surveys (reported in Areas 9 and 10). The total program is divided about equally between field stations and Washington, D.C.

On a subject-matter basis the program in this Area is reported under three subareas, all of which involve elements of basic research, applied research, and related technical service activities. These subareas are: (A) Water management and technology; (B) watershed research and planning; and (C) State and regional appraisals. Water-related research increasingly is becoming multidisciplinary. Major disciplines involved in addition to economics include hydrology, agronomy, engineering, statistics, and law. Expert help in these related fields is much easier to solicit in projects initially established on a multidisciplinary level rather than in projects involving only economists with a smattering of training in other fields who may have informal contact with other specialists.

Studies are carried out directly and in cooperation with Experiment Stations, Water Research Centers, and ARS research centers. During the reporting year, research was conducted in cooperation with the Hawaii, Wisconsin, North Dakota, Colorado, Georgia, Iowa, Oregon, Pennsylvania, Oklahoma, and Texas Experiment Stations; the Hawaii, North Dakota and Wisconsin Water Resources Centers; the ARS Great Plains Research Center (North Dakota); with all North Central and Western States through regional research projects. Additional cooperation of a regional nature is with the Water Resources Subcommittee of the Southern Land Economics Research Committee.

Approximately 16.1 scientist man-years were devoted to this area during the year. This included extramural research carried out under cooperative agreements.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 11.8 scientist man-years was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Water Management and Technology

Research cooperative with the Hawaii Agricultural Experiment Station is investigating the demand for irrigation water from the Molokai project for use on diversified crops, i.e., crops other than pineapple and sugarcane. Costs of production and yield estimates correlated with land productivity classes were prepared for 14 crop varieties adapted to the area. Honolulu market demand and supply relationships were estimated for several of the vegetable crops in anticipation of sharp price reactions to increased production from the irrigated area. The information was used in a model estimating a State competitive land-use pattern for the project area. A factor demand curve for irrigation water was derived for 1965 and one for 1970 is near completion. Research reports containing empirical results and describing the estimating procedure are in process. A companion study is investigating the value of water for sugarcane production in the State.

Studies of water management practices in the Northern Great Plains were initiated under new appropriations for FY 1966. The emphasis of the new studies is on moisture conservation measures for dryland agriculture (bench-terracing), sprinkler irrigation technology, and optimum irrigation water use on the Garrison diversion project. The former two studies are being carried out in direct cooperation with the ARS Northern Great Plains Research Center at Mandan, North Dakota and will utilize experimental data provided by the Center and satellite research locations throughout the Northern Plains. Level bench-terracing techniques for conserving moisture are being developed at the Center; similarly, considerable research attention has been given to developing more efficient methods of applying irrigation water through sprinkler systems. Economic evaluation of these methods will assess their potential for application in the Northern Great Plains. The third study, cooperative with the North Dakota Agricultural Experiment Station, has as its main objective the determination of yield response of selected crops to

irrigation water under alternative levels of fertilization, farming systems and other managerial inputs. Subsequently, yield responses will be evaluated in terms of economic criteria and relationships.

Participation in North Central Region Research Project--NC 57 (on Economic and Legal Factors in Providing, Using, and Managing Water Resources in Agriculture), consisted of providing a staff member on a reimbursable basis to serve as project coordinator and conduct research contributing to objectives of the regional project. Coordination activities include, besides providing overall direction, reviewing progress of the 11 participating States, preparing regional reports, and updating project statements. The coordinator also participated in a workshop on legal-economic research and was a joint author of a paper, "Organization for Legal-Economic and Related Research," to be published in the workshop proceedings (cited in Area 3).

Research contributing to the regional project consisted of estimating trends of irrigation in each North Central State as well as in the region as a whole. This analysis indicated a continuing increasing demand for water for irrigation in the region and in the individual States.

Related research was started in Wisconsin to determine and measure the economic effects of a permit system controlling the use of streams and lakes for irrigation. This project is conducted jointly with the Wisconsin Water Resources Center. An interview survey of irrigators in a selected county in Wisconsin will determine characteristics of irrigation enterprises using alternative sources of water and be used to analyze effects of the permit system on irrigation development.

A short-term cooperative project with the Wisconsin Experiment Station provided an overall view of the nature and extent of irrigation in Wisconsin. A mimeographed report indicated that the irrigated acreage in Wisconsin has increased at a rapid rate since 1939, but the increases have tended to be concentrated in a relatively few counties. The main source of water is from wells and the main crop irrigated is potatoes. However, other vegetable crops, particularly snap beans, have increased significantly in recent years in terms of total acreage irrigated.

A report entitled Rural-Agricultural Water Supply Systems: Irrigation was prepared in response to a request from the Joint Economic Committee of Congress. The report will appear in a document to be prepared by the Joint Economic Committee. The report discusses irrigation water supply systems that are either public facilities or group facilities operated by various types of irrigation water organizations. About half the land currently irrigated in the U.S. (estimated 38 million acres in 1966) is supplied water through such organizations. The discussion includes a general description of irrigation facilities, estimates of capital plant in irrigation facilities, costs and user charges, and trend of capital outlays for irrigation facilities. Changes in irrigation acreage and investment were projected to 1975.

Estimates of irrigation water requirements are being made for the various agroclimatic regions of the United States. The method employs techniques of

computing plant requirements for water under various climatic conditions as developed by Blaney, Criddle, and Thornthwaite. Basic data have been collected for California, the Northwestern States, the Southeastern States, and the Appalachian Region. A report including the estimation techniques and estimated irrigation water requirements for alfalfa, apples, and corn in the Appalachian Region is nearing completion. Reports for the remaining regions will follow.

A final draft of a technical bulletin on the economics of land forming was completed and is currently in process of publication by the Iowa Experiment Station.

A study testing the applicability of simulation techniques to problems of evaluating alternative water resource development projects and formulating alternative water resource management policies was completed in Oregon. The study included a case application concerning the Calapooia tributary of the Willamette River Basin in Oregon. A secondary objective of the study was to test the usefulness of the DYNAMO simulation language in river-basin modeling. Conventional techniques for economic evaluation were also reviewed, in preparation for presenting the simulation method and its application.

An economic analysis of the results of experimental irrigation of field corn on a major soil series in the Willamette Valley in Oregon was also completed. Yield responses were transformed into value terms on the basis of prices, various rates of water application, and such interacting variables as fertilizer and stand densities. Functions relating value to costs were then used to approximate optimum rates of water application to help farmers analyze the feasibility of irrigation as a production practice and to help water resource planning agencies evaluate irrigation as a component of multipurpose development projects.

A final research report on the use of welfare and institutional economics as tools in analyzing water resource management problems is in process. The study reflects the conflict between recreation and industrial use of the water resource in the Yaquina Bay area of Oregon (Benton County), and is designed to provide guidelines to resource management. Information generated by a Clawson-type demand analysis is used in coordination with a Leontief input-output model to quantify economic alternatives and their possible means of achievement, following welfare economics principles. These alternatives are then viewed in the light of existing water rights, pollution law, and State and local governmental institutional structures for resource management to delineate attainable solutions and feasible decision-making organizations. Results indicate that a 17-sector, small-area input-output model used was highly satisfactory as a means of determining both direct and indirect relationships between industrial and recreational sectors. The model indicates: (1) Regulation is only one of several feasible means of pollution control; (2) the effect of different pollution alternatives was limited to five of the 17 sectors, with an insignificant total effect on the local economy for each effluent disposal alternative; and (3) it appears that local governments or organizations are not sufficiently flexible nor do they possess the authorities needed to carry out an effective water quality management program.

B. Watershed Research and Planning

Work on pilot small watershed projects was authorized in the Department of Agriculture Appropriations Act of 1954. The purpose of these pilot watersheds was to demonstrate the feasibility of combining soil conservation measures with upstream detention structures to reduce frequent flooding. Joint ERS-SCS long-term appraisals to evaluate the effects of watershed installation improvements were continued on five of these projects during the past year: Six Mile Creek, Arkansas; Upper Rio Hondo, New Mexico; Mule Creek, Iowa; East Willow Creek, Minnesota; and Kiowa Creek, Colorado. Findings of these appraisals are applied in basic studies of the effects of reduced flood-plain risk on land use and damages, and in recreation benefit or other water management evaluations.

Collection of data for the 1965 crop year relating to land use, crop yields, production and management practices in the Six Mile Creek project has been completed. These data indicate a continuing trend toward a more extensive land use in the watershed. Progress is continuing on development of material for inclusion in the 10-year evaluation report, including a draft narrative.

Collection of land use, crop yields, and other associated items for the 1965 crop year has been completed in the Upper Rio Hondo watershed. Data on flood damages to crops, land, farmsteads and other agricultural improvements were also collected through farmer interviews. In addition, supplemental data were obtained from Soil Conservation Service and Forest Service personnel in the area. An evaluation report covering the period 1960-65 is in process.

As in past years, field survey data for the 1965 crop year were collected, tabulated and summarized for the Mule Creek project. These data include such items as land use, crop yields, flood damages, and conservation practices applied.

The continuing study of the East Willow Creek project requires that survey data be collected biennially. This was last done in March 1965 and will be done again late in 1966 or in 1967.

During the past year a survey of all farm operators was conducted in the Kiowa Creek Watershed. This survey was designed to collect data on the total farm operations as well as data on cropping patterns, yields, conservation practices, flood damages, and local opinions about the installed project. Results of this survey were used in conjunction with similar surveys in 1960 (the end of the project installation period), and in 1955 (prior to project installation), to evaluate the effectiveness of the project. Economic data were used in conjunction with physical data furnished by the Soil Conservation Service, U.S. Weather Bureau and U.S. Geological Survey to prepare an evaluation report. A draft of the report was prepared for field review by the cooperating agencies.

An annual inventory of basic data from Public Law 566 Watershed Work Plans provides facts which enable ERS to engage in systematic analyses of the relevant economic elements and planning phases of the small watershed program.

These annual inventories help answer various questions about small watersheds--such as the uses of land and water, types of benefits, types of costs, and estimated reduction in flood damages in watershed projects approved for operations.

The annual inventory of basic watershed data, covering national and regional totals and averages of damages, benefits, costs, and related data was continued. This inventory summarizes information taken from 729 project work plans authorized for operation as of June 30, 1966. The annual inventory of basic data within groupings of watersheds having similar characteristics is of significant application in improving planning procedures for ongoing and emerging P.L. 566 projects.

In addition, data from selected groups of watersheds were prepared to answer special requests. These included a summary by land resource area of selected statistics from approved P.L. 566 watershed projects in the North Atlantic Region. Also, data on damages, benefits, costs, land use and physical characteristics for works of improvement, were summarized from the Work Plans of Pilot Watersheds in the major water resource regions approximating the Great Plains.

Economic studies in the Washita River Basin, Oklahoma and Texas, are made to identify and evaluate physioeconomic relationships affecting the design and implementation of watershed development and management. The Washita River Basin is one of 11 designated by the Flood Control Act of 1944 for upstream flood control and soil erosion prevention projects. It contains 6,500 square miles of land area of which more than 90 percent is within the State of Oklahoma. Research is conducted at the Watershed Economics Research Laboratory, Stillwater, Oklahoma.

A small pilot study dealing with simulation models useful in optimizing the benefits of small watershed projects in the Washita River Basin, particularly flood protection and irrigation benefits, was completed. Work is progressing on a model that would simulate geographic variation in rainfall to be used in a more refined watershed simulation model. These simulation models are being developed for wider use in ex post evaluations of watershed projects.

Two reports were published by the Oklahoma Experiment Station on phases of the Washita studies dealing with the agricultural value of water stored in the sediment pools of floodwater retarding structures and on the effect of flood protection on land values.

Field work in the Central Washita Basin for the land use-flood damage study was completed for crop year 1965 and an interim report prepared. This report indicates the feasibility of the point sample technique to estimate (1) the land-based benefits of flood protection, and (2) flood damage relationships in small watershed projects. However, results of this preliminary survey indicated that a larger study area was needed in order to obtain data on a greater range in weather conditions during the period of study. Therefore, in addition to the intensive study area in the Washita Basin, the study was expanded to sample watersheds throughout the Arkansas, White and Red River Basins.

A study of institutional factors affecting watershed development is nearing completion. An article on the historical development of the watershed program in Oklahoma was published and two articles have been submitted to professional journals for publication. In Oklahoma, 219 sponsors and 435 endorsing organizations were found to be involved in assisting upstream watershed development programs. Among the endorsing organizations were civic and service clubs, municipal governments, businesses, lending agencies, and news media.

As a part of the institutional study, a technique was developed to rate the progress of upstream watershed development projects and compare time-lags for ranking watersheds. Discriminant analysis was used to classify current projects into four groups and to predict the group into which future projects would be expected to fall. Factor analysis of the 22 independent variables utilized in the discriminant program showed that 6 factors or "clusters" of variables could explain 77 percent of the variation in progress of project development. The discriminant and factor analyses were repeated on the watershed projects in the Washita Basin with similar results.

Work on the special studies of flood damage to crops and pasture continued during the year. The studies include analysis of flood damage information for corn in the Great Plains and Southeast areas. Efforts were made to improve the accuracy of a multiple curvilinear regression equation to predict percent productions in yield from floods of specified depths, durations and stages of crop growth. A report on this damage factor study for corn is in process. It is planned that similar work will continue for other crops during the next year. Data compiled in the Washita land use-flood damage study will also be useful in this effort to improve the reliability of flood damage factors to crops and pasture for use in watershed planning.

C. State and Regional Appraisals

A comparative study of methods of allocating irrigation water was conducted in the States of California, Colorado, Montana, Nevada and Utah. Types of organization studied included mutual ditch companies, conservancy districts, and irrigation districts. The study confirmed the existence of a wide variety of allocation practices among the States and among the various organizations within the States. Some of the allocation practices actually inhibit moves toward more efficient agricultural use of water. Lack of regulation in some districts results in over-appropriation of water rights, and disputes among water users. Adjudication procedures vary among the districts. Users are reluctant to utilize adjudication in districts with complex and time-consuming procedures.

A report on the economic impact of limited water supply showed significant decreases in returns from crops where irrigation was delayed because of water shortages. Even though total-season water supplies were adequate, temporary shortages accounted for the difference between profits and losses on irrigated crops.

A simulation program designed to test the economics of alternative routines for delivering irrigation water was developed with the Graduate School of Public Administration of Harvard University, with the principal ERS investigator stationed at Cambridge to facilitate the study. The simulation program as developed thus far can be used to consider irrigation systems that have up to 40 farms with 10 crops of four fields each, and up to 14 irrigation periods during a season. It can compute production, gross and net returns for each farm and for each system, thus determining the most profitable systems of irrigation. Simplified tests of the program are completed and work on more complex systems is underway. Some data for testing the program are available from California, Colorado, New Mexico, Utah, Mexico, Spain, and Morocco.

A review of literature on the concept of externality and its relationship to problems in water resource development was completed. The review revealed major areas of needed research, chief among which was methodology for quantifying (a) the effects of public investment in water resource development on the economy of localized areas, and (b) the specific interdependence of water resource development and other types of public investment, such as aid to education and maintenance of public health.

Research on the economics of water management in the High Plains of Texas is being performed under a cooperative agreement with Texas Technological College (Lubbock). Underground supplies of irrigation water in the High Plains, a 42-county area in the Texas Panhandle, are being depleted because of high pumping rates and insufficient recharge of aquifers. Farmers thus are faced with the problem of making the best possible use of a diminishing resource, and agriculturally-oriented communities suffer losses in economic activity as farm income is reduced by lack of water. Linear programming techniques are being used to estimate optimum use of the available water supplies. Currently, cotton and grain sorghum take priority over other crops in water use because of their relatively high value. Dependence on government agricultural programs is evident from the fact that 91 percent of the crops produced in the area are included in price-support programs. The continuing decline in water supplies has an effect on nonfarm as well as farm businesses. Some farm-supply firms in the area have reported a reduction of as much as 70 percent in gross sales income.

Separate research on measuring the economic impact of irrigation in different type-of-farming regions also focused on the High Plains as one of three selected areas for comparison. The High Plains comparison was between model irrigated and nonirrigated farms specializing in cotton and grain sorghum. The San Joaquin Valley (irrigated cotton), of California and the Mississippi Delta (nonirrigated cotton), were paired for study also. Respective production functions, deflated for technological change and shift indices of technical change, indicated the following general results: (a) New technology is adopted more rapidly with irrigation; (b) more labor, capital and other resources are employed in irrigated production; (c) average productivity of all inputs is higher under irrigation but the marginal productivity of capital is lower than in nonirrigated farming; and (d) each recurring drought seems to cause nonirrigated farms to further lose capacity to adopt new technology, a capacity that to begin with is less than that on irrigated farms.

Related regional economics research focused on exploratory work in representing the water variable in regionalized production functions and in computing marginal productivities of water in relation to other inputs. Also developed was a data systems procedure for minimizing the manipulation of county-unit or similar published data in compiling economic information for 25 different water resource regions of the United States. The procedure blends the aggregation of county-unit and State-unit published statistics with certain disaggregations of State-unit and national totals, so that a minimum number of published county estimates need to be handled individually in developing water resource region aggregates. Data for only 25 percent of the 3,000 plus counties in the United States need to be processed and identified to produce consistent and complet estimates on a single information item for all 25 water resource regions of the country.

Research was begun on the feasibility of supplemental irrigation as a means of increasing income in the Appalachian Region. While much of the agriculture in the region appears marginal or submarginal, irrigation may be a possibility for increasing productivity of farms, stabilizing farm income and maintaining economic activity in certain agriculturally-oriented communities. Previous research in the Southeastern States is being reviewed, and trends in irrigated acreage as shown in the Census of Agriculture are being investigated. Data are being developed on possible yield increases from crops presently produced in the region and new crops which might be introduced.

An important activity of the Economic Research Service in this area is participation in formal Department review of Federal agency reports and legislative documents dealing with water-resource development. Public works for resource development constitute a major item in the Federal budget. These include facilities for regulation and distribution of agricultural, industrial, and municipal water supplies; improvement of lakes, rivers and harbors for navigation and recreation; multiple-purpose development of river basins; regulation of water flows for pollution abatement and enhancement of fish and wildlife habitat; and hydroelectric power facilities. Proposed projects are designed to solve many problems in management of water and related land resources. Consequently, thorough reviews of such proposals are required in order to determine their conformity to accepted economic standards and compatibility with national goals and policies. During the year, reports on projects of the Soil Conservation Service, Corps of Engineers, and Bureau of Reclamation, as well as proposals for new legislation were subject to initial review and analysis. For each item reviewed, general and specific comments were prepared, as part of the official Departmental review process.

A. Water Management and Technology

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C. State and Regional Appraisals

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RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

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McKinney, R.D., and Barkley, Paul W. 1965. Some economic impacts of water reservoir development. Kan. Agr. Expt. Agr. Econ. Report 106. 64 pp.

Sitterley, John H., and Derr, Donn A. 1965. An inventory of water use, sources, reliability, quality and adequacy in rural Ohio. Ohio Agr. Expt. Sta. Research Cir. 135, Wooster, Ohio.

Snyder, J. Herbert. 1965. Stability in land and water use and economic aspects of ground water use and management. Proceedings, Biennial Conference on Ground Water Recharge, Development, and Management. University of California, Los Angeles, Calif.

Wu, Carson Kung-Hsien. 1965. The existing problems concerning water resources within and around the St. Paul - Minneapolis Metropolitan area.

AREA NO. 3. RESOURCE INSTITUTIONS

Problem. Efficiency in use of land and water resources is conditioned by laws, administrative measures, and related institutional arrangements that prescribe the rules and procedures for transfer, use, and management of resources. Rapid rates of population growth and urban expansion, imbalances in agricultural supply and demand, and technological change necessitate improved measures to achieve an orderly and balanced pattern of land and water development and use. Research is needed on the current status and innovations in water law, water use, and transfer arrangements; rural zoning and other land-use regulations; the organization and operation of resource districts and interstate compacts; and property rights in land, including public acquisition of various easements and other property rights.

USDA AND COOPERATIVE PROGRAM

A continuing program of research is conducted which provides inventories and analyses of resource institutions, including innovations that permit more efficient development and use of natural resources. Studies are carried out in four subareas: (A) Water rights and water legislation; (B) land-use regulations; (C) resource districts and organizations; and (D) property rights and impacts of public programs. Much of the research can be characterized as legal-economic utilizing basic information obtained from statutes, constitutional provisions, court decisions, local ordinances, and agency procedures to determine the nature of relevant laws, summarize them, and evaluate their economic impact on the use and development of natural resources.

Researchers are stationed at Washington, D.C.; Berkeley, California; Madison, Wisconsin; and Oxford, Mississippi. Cooperative agreements are in force with the Legal Institute for Agricultural and Resource Development at the University of Mississippi and Mississippi State University; the University of Minnesota; Wisconsin Water Resources Center; and the University of North Dakota Law School.

Federal personnel cooperate informally with other agricultural experiment stations and universities, with regional committees, and with other Federal and State agencies. A number of States have active projects on rural planning and zoning. Much of the work is coordinated with extension and other portions of the university. This problem area is developing as more regional development agencies are being formed. Analysis of special districts and related organizations has not been widely undertaken by State experiment stations. Cooperative work in this area is being started at Minnesota. Related work is carried out by California, which is closely tied to extension activities. Historically, this analysis has been undertaken by governmental research bureaus of the universities.

A total of 5.8 scientist man-years was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 2.0 scientist man-years was devoted to this area of research.

A. Water Rights and Related Laws

A comprehensive review and analysis of legal aspects of water rights in the 19 Western States was continued. A multiple-volume treatise on this subject is now near completion. Research in progress for this study includes preparation of chapters on ground-water rights, Federal-State relations, and updating of summaries of the water-rights laws of individual States. The several completed chapters deal with such subjects as policies in the 19 States, legal classifications of water supplies, and rights to use nonnavigable and navigable watercourses. Included are discussions of the appropriation and riparian doctrines, Pueblo water rights, ancient Hawaiian water rights, and the protection, loss, adjudication, and administration of water rights. Rights with respect to diffused surface and other waters are also discussed.

An analysis of the Utah law of water rights was published in cooperation with the Utah State Engineer and a similar analysis of the Wyoming law of water rights is underway in cooperation with the Office of the Wyoming State Engineer. A 1956 publication on the Idaho law of water rights is being updated and revised in cooperation with the Idaho Law Review. An updating and revision of another 1956 publication on irrigation water rights in California is nearly completed.

Research on legal aspects of water rights in the East also was continued. A first-draft manuscript has been completed on water-use regulatory functions of local governmental organizations in Florida. This includes a discussion of the authorized powers and duties held by a variety of local governmental organizations, as well as the experience of these local organizations in administering such regulations.

A comprehensive study of water laws in Wisconsin has culminated in a manuscript now undergoing final revisions. It includes an analysis of private and public water rights in Wisconsin; the role of State agencies and local units of government in shaping water rights; and related Federal, interstate and international matters and constitutional problems. This study further prompted and provided useful data and insights for a legal-economic analysis of irrigation in Wisconsin. A preliminary manuscript on the nature and extent of irrigation in the State was completed. Progress was made in developing a conceptual analysis concerning the economic effects of the Wisconsin stream-irrigation permit system. Data were obtained from the files of the administering agency and plans developed for personal interviews and related investigations in a selected area.

A study of the 1956 Mississippi legislation regarding the use of surface watercourses and related statutes and court decisions was continued. Examination and analysis of pertinent documents regarding permits and claims in the office of the administering agency have begun and additional data are being obtained to ascertain how the law operates in practice. A related economic analysis of water use in Mississippi was initiated on the effects of the 1956 and related laws.

Progress was made in the preparation of manuscripts dealing with water laws in Minnesota, Ohio, and Arkansas.

Other research during the reporting period included analysis of Eastern court decisions regarding ground water, historical development of the riparian and related doctrines, definitions of riparian land, rules regarding nonriparian use, and municipal use of water.

A paper on water rights in the Eastern States was presented at the Natural Resources Conference of the American Farm Bureau Convention. This paper was drawn upon for two presentations to a river-basin planning seminar and water-rights course participants at the University of Wisconsin and to participants in a natural-resources law course at the University of Mississippi. A paper on water-use laws was prepared for the 1967 Yearbook of Agriculture, and one on organization for legal-economic and related research regarding the use of water and other resources was presented at a Legal-Economic Workshop.

One researcher, as chairman of a regional research subcommittee, prepared a report on the status of water-law research in the North Central Region for the regional committee (NC-57), studying economic and legal factors in providing, using, and allocating water resources in agriculture. In addition, assistance was provided in the formulation of a contributing study of the Iowa water permit system.

Related activities of researchers included: chairmanship of a panel discussion on water resources administration at a conference sponsored by the Wisconsin Wolf River Basin Regional Planning Commission; critical reviews of reports including a chapter on water laws for the North Carolina Department of Water Resources and a summary of Kentucky water laws, policies and programs for the Ohio River Basin study commission; and preparation of a statement for the Soil Conservation Society of America on water allocation law in the Eastern States.

A study was begun of enforcement measures and water quality standards under the Federal-Water Pollution Control Act as related to agricultural and other rural resources. The initiation of detailed research on State water pollution laws is being considered.

A first-draft manuscript for a supplement to a previously published national bibliography on State water-rights laws and related subjects is being updated and revised. A draft manuscript of an annotated bibliography regarding Federal-States conflicts in jurisdiction over water resources also is in preparation.

Assistance was provided to the interdepartmental task force for the forthcoming international conference on Water for Peace. This included helping to prepare a task unit report on international law and the use and development of international rivers and river basins.

B. Land-Use Regulations

The principal orientation of this area of work is a two-part study of rural zoning enabling statutes and ordinances. The first part dealing with the enabling statutes is being summarized for review and clearance. About 400 zoning ordinances from all over the United States have been tabulated to determine what kinds of land uses are permitted in the various zoning districts. Analysis of the ordinances will be completed in the coming year.

Planning and zoning studies are also part of the Appalachian Regional studies program of the Division. Seventeen of the more populous Appalachian Regional counties have zoning ordinances. Some townships in Pennsylvania and Ohio also have zoning ordinances. In North Carolina, many cities have zoned areas extending one mile outside their corporate limits. Generally, the zoning ordinances provide for urban-type zoning districts and a few open-county zones, including agricultural, conservation and flood plain. The Wisconsin planning and zoning experience in the cutover regions could be used as a guide for Appalachian land-use development. For example, planning and zoning might be used to facilitate blocking up of forest areas; to guide summer homeseekers to areas where public services can be provided economically; to protect existing and potential recreation areas; to prevent duplication of roads and other public services; and guide growth of residential, commercial and industrial construction in rural areas. A publication reporting these findings is in process.

Several papers were prepared illustrating the need for including natural-resource capabilities in comprehensive plans for rural areas. Papers on this topic are being published in the Proceedings of the Eastern Caribbean Conservation Conference and the Yearbook of Agriculture. A publication, Comprehensive Planning for Rural Counties, is forthcoming as an Agriculture Information Bulletin. In addition to discussing the planning process itself, these publications point out the need for adequate consideration of land uses and available natural resources, including soil potentials, water, recreation, forestry, and fish and wildlife resources, in the planning process.

A second paper prepared for the Proceedings of the Eastern Caribbean Conservation Conference discussed recent legislative measures in Hawaii, California, and Pennsylvania to reduce tax burdens on farmland. The purpose of this conference at Caneel Bay, Virgin Islands, was to find ways of retaining prime sugarcane lands where land is required for housing and industrial development.

The relationship of flood-plain and conservation zoning to the small watershed program is being studied. One hundred and forty-five ordinances have been analyzed to determine types of zoning provisions that are compatible or supplementary to small watershed structures. About 33 counties in the United States contain both small watershed projects and relevant zoning ordinances. A schedule is being developed for field studies to explore the cooperative relationships between watershed projects and the governmental units having zoning authority.

A bibliography of materials concerning land-use changes resulting from urban expansion is nearing completion. Over a hundred items have been annotated, with citations to other items which were unavailable for review. At present, little progress has been made in developing reliable methods of estimating land-use transfers from rural to urban uses on any scale above the individual local studies. Publication on related legal-economic aspects of land use, and the planning process for development were also included in the review.

During the past year, the Land Use Planning Committee of the Soil Conservation Society of America planned and outlined a bulletin on rural planning and zoning to be published by the Society. A senior researcher, as a member of the committee, provided leadership in outlining the publication, wrote one chapter, and will be a senior editor of the publication.

C. Resource Districts and Organizations

Economic appraisal of local resource organizations was continued. A case study of Oklahoma enabling laws for special districts, previously reported, was released. A national inventory of the numbers and kinds of special districts was continued and a draft manuscript prepared.

A study of organizations and their structure for resource development was initiated in cooperation with the Minnesota Experiment Station. The objectives of the project are to: (1) Inventory the numbers and kinds of special districts in the State; (2) determine the effects of organizational and operational features on resource investments; (3) compare proposed multicounty districts organizationally and, where possible, operationally with existing districts; and (4) develop suggestions for alternative organizational and operational arrangements that would serve to improve investment decisions for resource districts.

Special resource and service districts in Colorado, and in many other States, have been judicially distinguished in their public and corporate status from traditional public and municipal corporation classifications. In Colorado, special districts have been designated as quasi-municipal corporations. This term, by definition and application, appears to limit the powers and functions which special districts could be created to perform. Legal research on the relevant statutes and cases which defines the powers of quasi-municipal corporations has been conducted and materials are being prepared for a report.

A review of special district enabling laws in 11 States encompassing the Appalachian Region was completed. Sixty-six selected statutes for creating natural resource special districts were analyzed in depth. About 200 functions ranging from soil and water conservation to installing community television antennas are permitted for multipurpose districts. Census data show that about 730 resource-oriented special districts operate in counties of the Appalachian Region. The final manuscript is in preparation.

A Digest of Federal Natural Resource Legislation for the years 1950-1965 was prepared. This Digest summarizes the principal points of laws dealing with soil and water conservation, water resources and watershed development, environmental and recreation development, commodity programs, and special research provisions. The document will be printed soon.

The senior researcher in this area also participated in a USDA study of ways to retain agricultural land as open space in the Potomac River Basin. This group was formed to prepare recommendations for the interagency Potomac River Task Force.

D. Property Rights and Impacts of Public Programs

Analysis of the feasibility of easements and protective covenants for guiding rural land use was discontinued in FY 1965. One journal article was published; another manuscript is in draft form.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Water Rights and Water Legislation

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Hutchins, Wells A., assisted by Jensen, Dallin W. 1965. The Utah law of water rights. State Engineer of Utah in cooperation with Natural Resource Economics Division, Economic Research Service, U.S. Dept. of Agriculture, Salt Lake City, Utah. 121 pp.

B. Land-Use Regulations

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Solberg, Erling D. 1966. Community land use planning. Yearbook of Agriculture, 1966. U.S. Dept. of Agriculture. (In process.)

Solberg, Erling D. 1965. Protecting natural resource values with zoning and related legal measures. Proceedings, Eastern Caribbean Conservation Conference. Virgin Islands.

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C. Resource Districts and Organizations

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RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

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AREA NO. 4. LAND TENURE

Problem. The security, efficiency, and general well-being of rural people and others can be improved through better tenure arrangements. Research of the firm is needed to help develop tenure devices that permit efficient and flexible organization of farms and other rural enterprises. To guide policies and programs, research is needed to determine the effects of economic change among resource owners and resource users and to determine the impact of various public measures on access to resources.

USDA AND COOPERATIVE PROGRAM

The continuing program of land tenure research is carried out in three principal subareas: (A) Basic information on tenure; (B) analysis of tenure arrangements; and (C) analysis of the structure of resource ownership and control. Studies carried out include collection and analysis of data on basic changes and trends in land tenure, patterns of landownership, forms of tenancy, and other devices for resource control; economic and legal studies of leasing and other tenure arrangements and their effects on efficiency, scale of operations, investments, and distribution of costs and returns; and effects of changes in conditions under which land is acquired, held, and transferred. Economic implications of land tenure arrangements and the legal and institutional framework within which such arrangements operate are studied.

Cooperative research is carried out in Washington, D.C., and at field locations, including Michigan State University, the Agricultural Law Center of the University of Iowa, and Colorado State University. Work by non-Federal personnel under cooperative arrangements also is done at the University of Cincinnati, Mississippi State University, and the University of Tennessee. Staff members also participated actively in regional research committees in the Great Plains, North Central, and Southern States, and in the Interregional Land Tenure Research Committee.

A total of 4.5 scientist man-years was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 7.7 scientist man-years was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Basic Information on Tenure

Research on the development and analysis of basic tenure information included an analysis of landownership patterns and changes in land use in Tennessee. This analysis was based on the 1960 Southeast Landownership Survey. A manuscript was cleared for publication by the University of Tennessee.

Cooperative research with Virginia Polytechnic Institute on landownership and land use in the low-income area of Appalachia continued during the year. Data from the 1958 and 1966 Conservation Needs Inventories and from other secondary sources are being assembled and analyzed to determine the physical factors that influence land-use adjustments. A questionnaire was designed to obtain additional data on economic and institutional factors from a sample of landowners in two counties of Appalachia.

Work is in progress under a cooperative agreement with the University of Cincinnati Law School to develop a system for collection, storage and rapid retrieval of information about land title, land use and other activities associated with parcels of land. A uniform coding system to classify the recorded information pertaining to parcels of land was developed.

B. Analysis of Tenure Arrangements

Research on the legal-economic analysis of contract farming was completed. Preliminary findings of this study were previously reported. A book-size technical manuscript is tentatively planned for publication as a USDA Miscellaneous Publication. In addition, four Farmers' Bulletins are to be prepared—three will consist of model contracts with related explanatory material for use in contract production of different commodities, and the fourth will be a general discussion of contract production, for use by farmers and others concerned with improving contract arrangements.

Participation continued in the North Central regional project on needed adjustments in land tenure to meet changing agricultural conditions (NC-53). Several of the special studies on tenure arrangements have been completed and some State reports have been published. To achieve a minimum-cost, market-clearing farm organization in the North Central Region, assuming by 1980, farm productivity increased at 1.75 percent per year, the following adjustments from the 1959 observed situation would be required: The number of farms to decline by 72 percent; acres per farm to increase by 243 percent; and capital used per farm to increase by 96 percent. The regional project is scheduled for completion on June 30, 1967. Several regional reports are planned, which will include: (1) The structure of midwest agriculture, as of 1980, if maximization of resource use is reasonably attained; (2) relation between the tenure conditions under which land is owned and operated and the attainment of needed adjustments, with emphasis on tenure innovations; and (3) analysis of conventional and unconventional tenure arrangements, with emphasis on such items as the corporate device, farm partnerships, credit instruments, farm leases, transfer arrangements, and attitudes and values of farm operators regarding ownership, control and indebtedness. A staff member is contributing leadership to and will participate in writing the regional reports.

A study of joint tenancy carried out by the Iowa Agricultural Law Center was completed and a technical monograph published. Another study completed and published examined the incidence of joint tenancy and reasons why owners had chosen this co-ownership arrangement. Land records in selected Iowa counties revealed that joint tenancy arrangements were created in less than 1 percent

of the land transfers in 1933, and in 52 percent of the transfers in 1964. Most joint tenancies are between husband and wife, and are virtually nonexistent between unrelated persons. Farms are in joint tenancy less frequently than urban property, and joint tenancy on higher value property is less frequent than on lower value property.

A study of the legal aspects of the small watershed program in Iowa was completed and the findings published as a monograph of the Iowa Agricultural Law Center.

Research on public access to public lands is being conducted under an agreement with the Bureau of Land Management. The Bureau administers some 170 million acres of unappropriated public domain lands in the 11 Western States. Recreational uses of some of these lands are restricted or prevented by a lack of physical or legal means of public access. Conflicts over access are growing in number and intensity as the demand for outdoor recreation presses harder on the supply of accessible public lands. The study examines the feasibility of resolving access conflicts by changing the laws, rules, regulations, and practices governing the allocation of public lands among competing private uses and users in order to better associate the costs and benefits among uses and users.

Staff members participated in planning a study, initiated at the Legal Institute for Agricultural and Resource Development of the University of Mississippi, to determine the economic, legal and social factors that inhibit farm consolidation and restrict an efficient use of agricultural resources.

C. Analysis of Structure of Resource Ownership and Control

Research on land tenure problems and policies of Puerto Rico was completed. Findings were previously reported. Manuscripts for a bulletin and two journal articles have been submitted for publication.

Preliminary research on the locus of entrepreneurship in agriculture was started at the Iowa Agricultural Law Center. An analysis will be made of the various contractual relations between farm operators and nonfarm businesses who supply farm inputs and/or process farm commodities, and other nonfarm entities who influence resource use, to determine what managerial functions and control of the farm business is being transferred from the farm operator to the nonfarm individuals, businesses or governmental bodies.

Several activities are not specifically identified with subareas of research or line projects. An important, continuing overall activity is participation in the work of regional research committees. Papers presented at the Symposium on Scientific Methods and Empirical Research sponsored by the Interregional Land Tenure Research Committee and at the workshop on Legal-Economic Research sponsored by the North Central Land Economics Committee were published during the year.

Attention was also given to land tenure reform activities, including consultations with foreign visitors. A position paper was prepared for the World Land Tenure Reform Conference sponsored jointly by FAO and the UN. A Division staff member was leader of the U.S. delegation and vice chairman of the conference. He prepared an evaluation of the conference from the point of view of the American participants.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Basic Information on Tenure

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Wunderlich, Gene, and Gibson, W.L., Jr. 1966. Choice of empirical techniques. In Methods for Land Economics Research. University of Nebraska Press, pp. 77-86.

B. Analysis of Tenure Arrangements

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C. Analysis of Structure of Resource Ownership and Control

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RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

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AREA NO. 5. OUTDOOR RECREATION AND IMPACTS OF URBAN GROWTH IN RURAL AREAS

Problem. Demands for outdoor recreation in rural areas are increasing. Urban expansion, new towns, and other nonfarm land uses are replacing crop and animal production in many areas. These changes have resulted in problems of transition, uneconomic developments, and unrealized potentials. Research is needed to guide public and private development to increase economic and aesthetic benefits and to minimize transitional problems.

USDA AND COOPERATIVE PROGRAM

Research is divided into the two following subareas: (A) Studies of outdoor recreation and natural beauty determine characteristics which influence demand for recreation, kinds and amounts of resources needed for various types of recreation, factors involved in public or private ownership and management of rural resources for recreation, and the related aesthetic effects and values associated with scenic beauty of the landscape. Studies under (B) transition of rural resources to urban uses, develop information and techniques for facilitating orderly transition from agricultural use to urban use in terms of tangible economic considerations and aesthetic standards.

Formal research cooperation was established with the Wisconsin and Virginia Experiment Stations and continued with the University of Michigan and the Maryland Experiment Station during the year. Informal cooperation is also maintained with many Government agencies, regional research groups, State experiment stations, and other organizations.

Approximately 4.1 scientist man-years were devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 17.5 scientist man-years was devoted to this area of work, of which 14.4 man-years were devoted to outdoor recreation studies and 3.1 man-years to studies of impacts of urban growth on rural areas.

PROGRESS--USDA AND COOPERATIVE PROGRAM

A. Outdoor Recreation and Natural Beauty

Preliminary work was initiated on economic studies of natural beauty. A paper exploring the basic structure of benefits from natural beauty was presented at the annual meeting of the Soil Conservation Society of America.

Studies of rural recreation enterprises are being carried out in the Appalachian Region. A field survey, based on sample areas drawn from the inventory of rural recreation enterprises made by the National Association of Soil and Water Conservation Districts and the Soil Conservation Service, was conducted during the summer of 1966. These data will be supplemented by information on farms reporting recreation income in the 1964 Census of

Agriculture. A case study of present and potential economic impacts from recreation development is being carried out in a five-county area of North Carolina and Georgia. It includes an analysis of trends in major economic variables, recreation activity levels for public and private developments, and will specify significant relationships. Preliminary observations from both studies indicate that a high proportion of small, part-time, rural recreation enterprises have rather low potential for economic returns and their lifespan tends to be short.

An analysis of recreation facilities operated by FHA borrowers was completed and a publication issued. Results indicate that water-based facilities for fishing, boating, and swimming were the most common enterprise. More than half of the enterprises have been established since 1962, and approximately two-thirds of the borrowers operated only one recreation enterprise. Respondents emphasized the need for professional assistance and guidance.

A study of rural recreation enterprises in Wisconsin was initiated in cooperation with the Wisconsin Experiment Station. Analyses will be made of costs and returns, capital investment, management problems, and potentials for various kinds and sizes of enterprises. The sample was drawn from the nationwide inventory of recreation facilities conducted by the NACD and SCS. County data from the same inventory for Walworth County, Wisconsin, were utilized for a report produced in cooperation with the University of Wisconsin to demonstrate uses of these data for planning adjustments in resource use. A study of loans made in Wisconsin by the Farmers Home Administration for farm recreation enterprises was supervised and a manuscript is under review for publication. A study of small resorts in a specialized recreation area of Wisconsin is underway.

The study of factors affecting decision-making about recreation developments in the Marquette-Alger area of the Upper Peninsula, Michigan, was continued in cooperation with the School of Natural Resources, University of Michigan.

A study of shooting preserves in Maryland was completed and published in cooperation with the University of Maryland. Significant findings were: (1) Most shooting preserves were secondary sources of income for the owners; (2) use of land for farming need not interfere with the shooting preserve enterprise; (3) land values probably prevent preserve developments in suburban areas (within 30 miles of Washington or Baltimore), and travel time limits the distance people will travel; and (4) all of the preserves studied had a need for improved management.

An analysis of the recreation potential of idle farmland areas in central and eastern Kentucky and similar nearby areas was made to help guide related research of potential resource uses and demand for recreation in large segments of Appalachia. This manuscript is being revised for publication.

A study of present use, potentials, and problems involved in recreation use of reservoirs developed by private power companies was conducted in cooperation with the Virginia Agricultural Experiment Station. Preliminary results

show that (1) demands for recreation uses of the reservoirs, located in or near Appalachia, have increased substantially in recent years, (2) the private power companies are interested in expanding the recreational services provided, primarily to improve public relations and as an economic measure, and (3) types of ownership and management patterns for recreation resources at the reservoirs vary widely among private power companies.

In addition to research, considerable staff assistance is provided for related activities. A staff member serves on the USDA Working Party on Outdoor Recreation. This committee functions as the USDA policy staff and supports participation of the Department on the President's Council on Recreation and Natural Beauty. A staff member also serves on the Department's Task Force on Special Rural Recreation Projects established by Assistant Secretary Baker. Staff assistance was provided for the 1967 Yearbook of Agriculture, "Outdoors U.S.A." A special report on rural outdoor recreational facilities was prepared for the Subcommittee on Economic Progress of the Joint Economic Committee of the Congress.

B. Transition of Rural Resources to Urban Uses

Recent work in this subarea is aimed at supplementing available information on urbanization of rural areas and the improvement of planning techniques for guidance of transitions in land use and community organizations.

Airphotos have become an increasingly versatile tool for planners and are used for preparing land-use maps, measuring land and water areas, inventorying recreation sites, etc. An Agricultural Handbook was published which describes how airphotos are made and how they may be used as an aid in planning.

The concept of creating new separated population centers in rural areas to accommodate the growing population has received increasing interest. The information on "new towns" is sparse and widely scattered. A selected, partially annotated bibliography on new towns and a report on the location and characteristics of new towns, planned communities, and large subdivisions are in preparation. A list of bibliographies on urbanization, the planning process, and land use change is being prepared. A report on the work of the USDA that is helpful to rural and urban planners, together with a bibliography of USDA publications having special interest for planners, also is in process.

A study of the new town development at Columbia, Maryland, is being planned. This study will consider the impact on rural land use and rural institutions and opportunities for reducing transitional problems with respect to planning and the reorientation of government programs, particularly those of USDA and local governments.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Outdoor Recreation and Natural Beauty

Christiansen, R.A., and Staniforth, S.D. 1966. An inventory of private recreational developments in Walworth County. Dept. Agr. Econ. Staff Paper Series No. 7. University of Wisconsin. 18 pp.

Huff, Judith M., and Johnson, Hugh A. 1966. Recreation facilities and services operated by FHA borrowers. U.S. Dept. of Agriculture, ERS-294. 12 pp.

Johnson, Hugh A., and Huff, Judith M. 1966. Toward measuring the intangible values of natural beauty. Proceedings, Annual Meeting Soil Conservation Society of America, Albuquerque, N. Mex.

Johnson, Hugh A. 1966. Do we have the answers? Research needs in outdoor recreation, 1966. Presented at four Regional Recreation Workshops in Pennsylvania. U.S. Dept. of Agriculture, ERS-____.

Johnson, Hugh A. 1966. Second homes. Yearbook of Agriculture, 1966 U.S. Dept. of Agriculture. (In process.)

Schermerhorn, R.W., and Starkey, W.K. 1966. An economic feasibility study of shooting preserves in Maryland. Md. Agr. Expt. Sta. Misc. Pub. 584.

Staniforth, S.D., Christiansen, R.A., and Walter, R. 1965. Cabin resort income in northern Wisconsin. Wis. Agr. Expt. Sta. Bul. 576.

Stipe, Sterling H., and Pasour, E.C. 1966. Economic enterprises for selected recreational enterprises in the North Carolina Piedmont. North Carolina Agr. Expt. Sta. AE____. (In process.)

B. Transition of Rural Resources to Urban Use

Crosswhite, W.M., and Vaughn, G.F. 1966. Suburban development in metropolitan northern Delaware. Del. Agr. Expt. Sta. and Univ. Del. Agr. Ext. Serv. Coop. Bul. 3. 26 pp.

Davis, Jeanne M. 1966. Uses of airphotos for rural and urban planning. U.S. Dept. of Agriculture Agr. Handbook 315. 40 pp.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

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Andrews, Boyd, and Klussman, Wallace. 1965. Outdoor recreation. Agr. Ext. Service, Texas A & M University.

Badger, Daniel. 1965. Recreational considerations in water planning. 10th Annual Water for Texas Conference. Dept. of Agr. Econ. A.E. 6517. Texas A & M University.

Burdge, Rabel J. 1965. Selected occupational influences on the use of outdoor recreation. Annual Meeting of Rural Sociological Society, Chicago.

Clonts, Howard A., and Gibson, W.L., Jr. 1966. Complementing open space preservation in the National Capital Region--Maximum land values farming can sustain. Va. Agr. Expt. Sta., Blacksburg, Va.

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Hamilton, Lawrence S. and Van Nierop, E.T. 1966. Should we fish and boat on our reservoirs? N.Y. State Conservationist 20(2):12-14.

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Merriam, L.C., Jr., and Price, M.B. 1965. Some considerations in planning for outdoor recreation in Montana. Montana Business Quarterly (Spring):18-33.

Owens, Gerald P. 1965. Nature of investment, expense and income of successful outdoor recreation enterprises in Ohio. Dept. of Agr. Econ. and Rural Sociol. Series A.E. 372. Ohio State University.

Sargent, Frederick O. 1966. Ideas and attitudes: A scenery classification system. Jour. Soil and Water Conserv. 21(1).

Schmedemann, Ivan W. 1965. Discussion: The role of recreation in solving leisure-work problems. Proceedings, Annual Meeting of Association of Southern Agricultural Workers, Dallas, Texas.

Schmedemann, Ivan W. 1965. Leisure time. Proceedings, Twentieth Annual Town and Church Conference, College Station, Texas.

Traver, C.E. 1966. Annotated bibliography of research and materials relating to camper characteristics and preferences. Dept. of Agr. Econ., Cornell University.

AREA NO. 6. RESOURCE INCOME DISTRIBUTION

Problem. The economic well-being of rural people and others over time is determined by levels and distribution of resource income. Allocation of income to factors of production is affected by functioning of factor markets, tenure institutions, other institutions and public programs. Changes in land income have major distributional effects in the form of capital gains or losses. Public programs having benefits incident to land create capital gains to initial landowners, but these gains eventually become increased capital requirements and production costs to new generations of landowners. If this occurs, an added consequence of such programs could be lower income to labor used in farming. Research is needed on the distribution of resource income, particularly on how it is affected by the interrelationships of public programs, tenure institutions, other institutions, and technological advance, and how people in local nonfarm sectors are affected by public programs directly concerned with agriculture.

USDA AND COOPERATIVE PROGRAM

The program of research emphasizes studies of effects of natural resource-oriented institutions, policies and programs upon the distribution of resource income. Analyses are made of past, current and prospective levels of land resource income and relationship of these levels to other factor shares. Emphasis is placed upon determining the role of land and other institutions in distributing gains and losses arising from public programs. The indirect effects of farm programs are evaluated through estimation of structural relations among sectors of agriculturally based local economies and through additional study of resource fixities within these sectors. Much of the program is carried out cooperatively with the Agricultural Experiment Stations, including, during the reporting period, the Minnesota, Colorado, Kansas, Louisiana, Iowa, and North Carolina Experiment Stations.

Approximately 5.2 scientist man-years were devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

Except for the State Experiment Stations cooperating in this program of research, the State stations have no research classified specifically in this area.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Distribution of Resource Income

Research initiated during FY 1965 to analyze trends in land income was nearly completed during the past year. This work being carried out cooperatively with Iowa State University had the major objective of increasing understanding of the more rapid increase in land income and values in recent decades than the increase in farm income. Two statistical models were used in the analysis: (1) A recursive time series model with two equations and with the Nation as

the unit for analysis; and (2) least-squares regression in selected time periods (cross-sectional analysis), and with the 48 contiguous States as the units of observation. The fitting of secondary data to both models indicated the following variables to have a significant positive effect on the value of farmland: Expected net farm income, government payments for land diversion, conservation payments, expected capital gains, farm enlargement, nonfarm population density, technological advance and the ratio of debt to equity. Increases in voluntary transfers of farmland, the capitalization rate, and the expected ratio of farm to nonfarm earnings had negative effects upon the value of farmland. A multilithed report on this research is completed, and a bulletin is in process of preparation for publication.

Work initiated during the year on analysis of variations in income of rural farm people in Minnesota emphasizes cross-sectional regressions with counties, or clusters of counties, as the units of observation. Major variables in the regressions are natural resources (quantity-quality index), population attributes such as age structure and education, and degree of urbanization. Assembly of secondary data for the analysis is nearly complete, and the work is expected to be completed in the next year.

B. Incidence of Benefits and Costs of Public Programs

The main activities during the year on studies of the incidence of benefits and costs of public programs were development of concepts, hypotheses and methodologies for use in estimating effects of alternative changes in public programs upon local farm and nonfarm populations in the North Central Piedmont, Southwestern Louisiana, and Central Great Plains. A two-day workshop was held on regional studies of income distribution for the purposes of (1) reviewing the major analytical and empirical methods in regional analysis and an assessment of their applicability for income distribution studies, (2) analyzing conceptual problems of incorporating resource fixities and immobilities in regional models, and (3) assessing the potential of simulation techniques in projecting effects of farm program changes upon local farm and nonfarm populations. Twelve individual papers and two formal reviews were presented at the workshop.

A second workshop of two and a half days was held at Raleigh, North Carolina for the purposes of (1) assessing the state of income distribution theory, (2) examining the relations of factor market performance and income distribution, and (3) expressing hypotheses on the distributional effects of public programs. Personnel of the Natural Resource Economics Division contributed two papers to this workshop: (1) "Externalities and Their Effects Upon Income Distribution," and (2) "Distributional and Redistributional Effects of Flue-Cured Tobacco Programs." The first paper stressed a classification of externalities and the significance of factor and product markets in transmitting income and wealth distributional effects to owners of fixed or immobile resources. The second paper stressed the need for distinguishing the differing populations in the local area for purposes of expressing and testing hypotheses on distributional and redistributional effects of flue-cured tobacco programs. In addition, a member of the faculty at the

University of Minnesota, who is cooperating with the Division in income distribution studies, presented a paper at the workshop entitled, "Influence of Urban-Rural Interdependencies Upon Functional and Personal Distribution of Income."

During the year, work was initiated on assembling secondary data for the regional analyses to be made for Southwestern Louisiana and the Central Great Plains. Also, much data were assembled from ASCS records for analyzing the Great Plains Conservation Program. These data from SCS records pertained to expenditures in the program by years, by practices, and for the individual counties with cooperators, since it was initiated in 1956.

Cooperative research with North Carolina State University on the interrelationships of tenure arrangements and public programs in determining trends in resource income distribution in flue-cured tobacco production areas was nearly completed during the year. Publications are in process of preparation. The major findings in the research were (1) the inflexibility in provisions of tenure arrangements during the period since 1920 has not prevented the accrual of most program benefits to landowners, and (2) the major components of the increases in rents to landowners arising from the program were yield and price increases.

During the year the senior member of this research area participated in related regional research committee work, including subcommittees on income distribution of the Southern Land Economics Research Committee and of the Interregional Land Economics Research Committee.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Resource Income Distribution

Back, W.B. 1966. Discussion: Income effects of innovation: The case of labor in agriculture. Jour. Farm Econ. 48(2):336-338.

Back, W.B., and Wunderlich, Gene. 1966. Classification in the research process. In Methods for Land Economics Research. University of Nebraska Press. pp. 55-74.

Back, W.B. 1966. Summary and positive suggestions. In Regional Economic Development. Proceedings of Methodology Workshop. Great Plains Resource Economics Committee, Oklahoma State University. pp. 132-135.

Chryst, Walter E. and Back, W.B. 1966. Perspectives on content and methodology of land economics. In Methods for Land Economics Research. University of Nebraska Press. pp. 1-18.

Strohbehn, Roger W. 1966. Externalities and their effects upon income distribution. Proceedings of Workshop on Income Distribution. Agr. Policy Institute, N. Car. State University. (In process.)

B. Incidence of Benefits and Costs of Public Programs

Back, W.B., and Waldrop, John E., eds. 1966. Regional analysis of income distribution. Dept. of Agr. Econ. Louisiana State University and Natural Resource Econ. Div., Economic Research Service. Papers contributed by Division staff and cooperators include:

Back, W.B. Data requirements, sources and problems for estimating resource supply functions. 3 pp.

Goode, Frank. Survey of analytical methods. 13 pp.

Hartman, L.M. Some considerations for a regional income distributional model. 7 pp.

Landgren, Norman. Interpretative summary and general assessment in relation to project purposes. 4 pp.

Skold, Melvin. Problems and potentials in simulating regional economies. 14 pp.

Stahl, John. Simulation as a technique in regional analysis. 7 pp.

Strohbehn, Roger W. Relevance of resource supply functions in regional analysis. 8 pp.

Waldrop, John, and Hudson, Andrew. Availability of local data for use in regional analysis with special reference to Louisiana. 7 pp.

Back, W.B., and Wunderlich, Gene. Distributional and redistributional effects of flue-cured tobacco programs. Proceedings of Workshop on Income Distribution. Agr. Policy Institute, N. Car. State University. (In process.)

AREA NO. 7. QUALITY OF NATURAL RESOURCES

Problem. The quality of natural resources in many communities has been altered by population growth, industrialization, economic expansion, and unprecedented changes in science and technology. Public interest and concern regarding quality of our resources has resulted in recent Federal legislation. Passage of the "Water Quality Act of 1965," and the "Clean Air Act, amendments," which includes the "Solid Waste Disposal Act" and the "Motor Vehicle Air Pollution Act" demonstrate this concern. Growing concern about possible adverse effects of agricultural operations on resource quality is also evident. Research is needed to develop economic information and conduct analyses on problems directly related to the quality of natural resources in rural areas, including particularly adverse effects of chemical pesticide residues, disposal of animal waste, air pollution damage to crops, and adverse aesthetic effects from economic activities. This area of research focuses on development of economic information and techniques of analysis to determine optimum compromises between production efficiency and adverse monetary and aesthetic effects.

USDA AND COOPERATIVE PROGRAM

The establishment and enforcement of quality standards for water and air could have both adverse and beneficial effects on agricultural operations. It is essential to develop economic information to assess the impact of quality standards on agriculture and to more adequately determine the magnitude of agriculturally-originated waste.

Studies are made of the nature and sources of rural area pollutants, trends in adverse impacts and changes in technology which may improve or intensify adverse effects on the quality of land, water, and air resources. Case studies of adverse effects are carried out and alternative measures for control are evaluated. Conceptual and quantitative studies are conducted to improve techniques for the appraisal of adverse effects and to develop planning procedures for the consideration of resource quality in comprehensive resource planning. Cooperation has been established with the Iowa Experiment Station and the University of Michigan. The technical nature of the subject matter area requires that cooperative working relationships be established with physical scientists and other specialists both within and outside the Department.

Approximately 0.5 scientist man-year was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 0.9 scientist man-year was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

This research was initiated as a formal reporting area this year in recognition of staff work and research activities and the emerging problems in environmental quality which have been summarized by two reports, "Restoring the Quality of Our Environment," by the President's Science Advisory Committee, and "Waste Management and Control," issued by the National Academy of Science.

Staff members have participated with the Water Quality, and the Sedimentation and Erosion Control Work Groups of "Project Potomac." Problems of agricultural pollution, animal wastes and sedimentation, are being considered. Quality standards for agricultural water are being evaluated in another ad hoc Department work group.

A literature survey of the effects of pesticide residues on soil and water resources was carried out in cooperation with the University of Michigan. This study indicated that movement of pesticide residues into water supplies was highly correlated with sediment movement. The sediment movement mechanism indicates that standard sediment control measures may have a high potential for the protection of water supplies for domestic, recreational, and other uses.

Cooperative research was initiated with Iowa State University to carry out analysis of water pollution from pesticides and other agricultural wastes. Present techniques for evaluating economic impacts of pollution will be improved and agricultural pollution control alternatives will be evaluated in a watershed case study.

Support was provided for a legal analysis of the "Water Quality Act of 1965," with particular reference to its relevance for rural areas.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Humphrys, C.R. 1965. The silent corrupter of water. Michigan Out-of-Doors. 16(11).

Linton, Robert E. 1966. Some methods of poultry waste handling and disposal. Dept. of Agr. Econ. Mimeo. Report A.E. 387. Cornell University.

Timmons, John F. 1966. Economics of water quality use and control. Seminar Proceedings, Iowa's Water Resources--Pollution Control and Abatement. Iowa State University.

AREA NO. 8. DATA AND PROJECTION SYSTEMS FOR NATURAL RESOURCE PLANNING

Problem. Development of comprehensive plans for all major river basins was recommended by the Senate Select Committee on National Water Resources in its report of January 1961. This recommendation is being carried out through a cooperative interdepartmental program of surveys conducted under the auspices of the Federal Water Resources Council. The product of these surveys is to be a generalized plan for the development of the water and related land resources of each of the Water Resource Regions. Formulation of these plans requires an adequate framework of economic data, projections, and systems of analysis. Moreover, these data, projections, and analytical systems should be consistent among regions and with national expectations in order to avoid grossly under or overstating the potential of any single region. To obtain such consistency requires that the generation of the above elements be coordinated. It is the aim of this area of research to produce economic data and projections for the Water Resource Regions that are internally consistent and to develop systems of analysis appropriate to both inter- and intraregional analysis of the data and projections.

This type of economic research is needed to identify potentials for developing major water resource regions and to relate their relative economic efficiencies to emerging national and regional requirements and objectives. Continuous reappraisals are required to evaluate changes in the potential supply of and demand for natural resources in relation to development potentials of the various regions.

USDA AND COOPERATIVE PROGRAM

Current activities are concerned with the following areas: (1) Development of a bank of data related to natural resources and of systems appropriate to the processing and retrieval of these data; (2) development of a set of projections of economic activity and resource use in the agricultural and related sectors for the Nation and for Water Resource Regions; and (3) development of econometric methods of analysis and projections for use in studies of the water and related land resources in each Water Resource Region or River Basin.

A total of 2.5 scientist man-years was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Development of a Data System Related to Natural Resources

Progress continues on the development of data pertaining to natural resources available in a form that will lend itself to ready use in economic analysis. Economic analysis of water and related land resources requires data of many

types and from many sources. Types of data include physical measures of land and water resources, qualitative measures of those resources, and information to measure the impacts of natural resource use and development on regional and local economies. Much of the data are not directly available. Therefore, "proxy" elements must be sought that can be measured and which in turn tend to measure the basic element itself. The first step in developing such a system has been taken. Approximately 300 items, on a county basis, from the 1949, 1954, and 1959 Censuses of Agriculture have been converted to magnetic tape. Verification of the accuracy of the conversion is nearing completion. A computer system is operational that allows rapid, inexpensive, and flexible retrieval of this information. Plans are underway to add items from the 1964 Census of Agriculture to this system. Additional sources and types of data for inclusion in the data system are being examined.

B. National-Interregional Analyses and Projections of Economic Activity and Resource Use in the Agricultural and Related Sectors

This activity involves examination of major factors expected to shape future changes in the geographic distribution of agricultural output and employment. They include: (1) Agricultural production and marketing technology, their differential effects between regions and subsectors of the agricultural economy and their impact on the structure of related economic sectors; (2) regional differences in availability, quality, and productivity of the natural resource base and related potentials for increased output in terms of production cost differentials; (3) transport cost factors relative to future centers of consumption, as indicated by population projections; (4) prospective depletion of natural resources available for agricultural use resulting from depletion of ground water, deterioration of soil resources, and encroachment by nonagricultural developments; and (5) tradition, institutions, public programs and other factors that influence the location of agricultural activity through their effect on agricultural output and land use.

This activity is carried out in cooperation with the Office of Business Economics, Department of Commerce, which prepares projections for the U.S. and Water Resource Regions of population, employment, and other measures of economic activity in the nonagricultural sector of the economy.

ERS responsibility includes projecting agricultural employment and income, land use patterns, and production of the major agricultural commodities as well as the impact of the projected levels of agricultural output on sectors structurally related to agriculture. (These latter projections will be closely coordinated with the work of OBE.) Preliminary projections of this type were made for the 16 Water Resource Regions and are now being reviewed prior to publication. The projections are based on analysis of the historical relationship between the national economy and that of the individual regions as modified by projected losses or gains in the resource base of each region. Simultaneous regional allocations of projected national food and fiber requirements, established estimates of regional agricultural output consistent with national needs. This set of national-regional projections is being used in framework studies (reported in Area 9), of the Ohio, Upper Mississippi, and Missouri River Basins and will be used in a similar study of the Columbia-North Pacific Region.

C. Integrated Econometric Systems of Economic Analysis and Projections for Use in Framework Studies

This area of activity supports Area 9, Regional Appraisals for Natural Resource Development. The latter area requires the simultaneous handling of many types of input data collected from numerous sources. Since the general pattern of analysis in regional, or framework, studies is similar in nature, it is expected that economies in operation and more consistent research results will be obtained by using a generalized, integrated system of processing and analysis. Progress to date consists chiefly of developing an automatic data-processing system to summarize land-use data and related it to current cropping patterns, production data, and water resource development potentials by soil resource groups.

A. Development of a Data System Related to Natural Resources

Holm, Paul L. 1966. Types of economic data being developed by OBE and ERS for possible use in research and planning. In Regional Economic Development. Proceedings of Methodology Workshop. Great Plains Resource Economics Committee, Oklahoma State University. pp. 119-131.

AREA NO. 9. REGIONAL APPRAISALS FOR NATURAL RESOURCE DEVELOPMENT

Problem. A critical and increasing national need exists for comprehensive long-range regional planning for development and conservation of water and related land resources. Early resolution of problems associated with the planning of small areas is required as regional plans are developed. Proposed projects can fail to achieve optimal development because of less than full consideration of all needs and development potentials. A restricted or fragmented approach to planning also interferes with full consideration of alternative sources and costs of products and services obtainable from water development projects. Reflecting these problems which have long been recognized by professional workers, the Senate Select Committee on National Water Resources in its report of January 1961 recommended the development of comprehensive plans for all major river basins of the Nation. This recommendation is being implemented by current coordinated planning efforts of a number of Federal agencies working under the general guidance of the Federal Water Resources Council. Completion of the coordinated program of comprehensive surveys for major water resource regions of the Nation is scheduled for 1972.

Long-term regional strategies for water resource development are expected from this program. The results are expected to embrace the following:

1. Identification of future patterns of water and related land use considered most desirable and appropriate.

2. A general plan and schedule of water resource development, by subbasin, required to achieve the desired pattern of water and related land use.

3. Analysis of the economic implications of alternative plans and schedules of development.

4. Development of analytical systems for modifying the plan as new information or unanticipated events, may require.

In summary, the framework investigations should make two major contributions: Generate a matrix of physical and economic information from which plans for effective and balanced systems of water resource development may be formulated; and, in the aggregate, provide information needed to shape national water policy.

USDA AND COOPERATIVE PROGRAM

Studies undertaken by the Natural Resource Economics Division, ERS, are coordinated with survey efforts of the Soil Conservation Service, the Forest Service, and other Federal Departments and carried out under the general guidance of the Water Resources Council. Work carried out by the Economic Research Service involves the following elements:

1. Analyses and projections of economic activity in the agricultural and related sectors of the economy.

2. Projections of the demand, supply and use of land resources for agricultural and other rural purposes.

3. Analysis of agricultural and rural water problems as they relate to the volume composition and value of production, employment, and levels of income in affected communities.

4. Assessment of agricultural and rural needs for water and related land resource development.

5. Appraisal of the economic effects and consequences of development alternatives on the agricultural and related sectors of the economy, and dependent rural communities.

Although basic research is undertaken, emphasis is on applied research. The work is carried out in 26 field locations and in Washington, D.C. Regional headquarters are maintained at Little Rock, Arkansas; Fort Collins, Colorado; East Lansing, Michigan; Upper Darby, Pennsylvania; and Logan, Utah.

Survey data and analyses reported for this area of work are prepared for use by agencies cooperating in coordinated water resources planning and are available as joint reports with the cooperating agencies. Reference documents and research reports reported as publications for the area are available from regional offices.

A total of 9.1 scientist man-years was devoted to this area of work during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

The Ohio River Basin Study is nearing completion. A report of the projected agricultural economy indicates that under specific assumptions, and without water resource development, all but 1.5 million acres of crop and pastureland will be in use by 2010. This is 11.5 million acres more than are expected to be used by 1980.

Analysis of the drainage and irrigation potential on agricultural lands in the Ohio River Basin was completed during the year. Results of these studies and an application of the findings to the Basin's agricultural water development needs were reported in a reference document for the Agricultural Appendix of the Ohio River Basin Comprehensive Survey.

There is an economic potential for 5.6 million additional acres of agricultural drainage by 2020. The economic potential for irrigation greatly exceeds current usage. Rural-farm domestic and livestock water use was projected by subbasin and is expected to double by 2020. Expected shifts in livestock production implies need for additional water development in certain subbasins.

A supplement to the agricultural economic study outlining in detail the assumptions and methodology used in all aspects of the Ohio River Basin Study is being prepared.

The Upper Mississippi River Basin Study is in its second year. Projections of national food and fiber requirements were completed during the year. A share of these requirements was allocated to the Upper Mississippi Region, based on historical production patterns. Estimates of changes in the productive capacity of the land resource and feeding efficiencies for livestock were developed in cooperation with agricultural experiment stations in Wisconsin, Minnesota, Iowa, and Illinois. These data were incorporated in a projection model to estimate the likely use of land resources in agricultural production.

A preliminary report outlining the results of the Economic Base Study is in draft stage. By the year 2020, over 4.0 million acres of existing pasture and cropland is expected to be converted to nonagricultural uses. Under the specific assumptions of the analysis, indications are that without water resource development the projected share of national food and fiber demands cannot be met by Basin farmers beyond 2000.

Analysis of the flood plain, irrigation and drainage potential on agricultural lands in the Upper Mississippi River Basin is beginning. In view of the limited land resources, water development for agriculture should be very beneficial. A report summarizing the Basin projections and projection methodology is in process.

Missouri River Basin. Preliminary economic projections were completed for three subregions within the Basin and are being prepared for the remaining subregions. Resource productivity and production cost data are being prepared for use in assessing future development needs. Field collection of current crop yields and cropping patterns by soil groups within land resource areas was completed and arrangements were made with the nine land-grant colleges in the Missouri River Basin to develop projections of production response, fertilizer use, and associated production costs. In addition to the above activities, some time was devoted to formulation of the analytical model for assessing future development needs.

Columbia-North Pacific Region. This survey is new and progress consists largely of developing a plan of work for the agricultural and food processing sectors for the Economic Base Study and outlines for irrigation and land development studies. Cooperative work was initiated with SCS to inventory of land resources, production, yields, fertilizer application, and estimate production costs. Secondary data on land and water use, agricultural output, farm characteristics, employment, and income are being compiled.

Colorado Economic Base Study. This study is cooperative with the Federal Water Pollution Control Administration. Separate analyses of six subbasin areas of the Colorado River are involved. Projections are made for total economic activity by sectors in each subbasin for 1980 and 2010 with (1) no water constraints, (2) quantity constraints, and (3) quality constraints.

In the past year, analyses included quantity and quality constraints. The study is near completion.

Economic studies of water quality in the Lower Main Stem Subbasin, ground-water depletion in the Gila Subbasin, and the Palo Verde area in California are included in the program of studies. A substantial decrease in irrigated ground-water tables is indicated by the analysis. Value of production may increase markedly, however, because of crop yield increases and intensified cropping.

North Atlantic Region. The comprehensive study for the region was initiated during the year, and an interdepartmental plan of survey and agency work plans prepared. Statistical summaries of the agricultural and rural economy of the region are being prepared. Division studies will emphasize both the nonagricultural and the agricultural aspects of the rural economy, and the effect of economic development on regional water problems and needs. Special attention will be devoted to expanding recreational demands in the region and the locational influence of such demands on regional water resource development.

The Appalachian Water Survey. Special attention is given in this study to water development potentials for stimulating economic growth and improving the welfare of the people in the region. Water and related land-resource problems considered include flood control, water quality management, water supply, agricultural water needs, hydropower development, recreation, fish and wildlife, and navigation. Economic studies in the survey are oriented to 23 functional economic areas delineated by the Office of Business Economics, U.S. Department of Commerce. The major objective is to identify water development projects that constitute harmonious and essential elements of an overall program for economic development. Division studies are directed toward the goal of identifying water-based opportunities for economic development in rural areas with special attention given to effects of improved transportation and other elements of the economic development program.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

Andersen, Jay C. 1966. Interindustry analysis of the Colorado River Basin--A brief description and special problems in agriculture. Proceedings, Western Farm Economics Association. 8 pp.

Cotner, M.L. 1965. The role of agricultural water resource development in regional growth. Mich. State University and NRED-ERS, Agr. Econ. Misc. 1965-13. 18 pp.

Stewart, Clyde E., and McArthur, J'Wayne. 1965. Projections of production and processing of selected agricultural products--Upper Columbia River Basin. ERS, U.S. Dept. of Agriculture, Logan, Utah. 36 pp.

Steele, Harry A. 1966. Grants to States for comprehensive planning under the Water Resources Planning Act. In Proceedings, Midwestern States Flood Control and Water Resources Conference. Missouri Water Resources Board. Jefferson City, Mo.

Steele, Harry A. 1966. Economics of water resources planning. In Proceedings, Ohio Water Quality and Recreation Conference. Water Resources Center, Ohio State University, Columbus, Ohio.

Steele, Harry A. 1966. Water and land resources--potentials and requirements. Eleventh Annual New Mexico Water Conference. Water Resources Center, New Mexico State University, University Park, N. Mex.

AREA NO. 10. RIVER SYSTEMS PLANNING

Problem. Management and development of water and related land resources is a source of concern in vast areas of the country. Among the conditions of concern are: (1) Critical water shortages, causing distress in both rural and urban areas; (2) deterioration of water quality; (3) increased demand for water resulting from increased population and growth of water-using industries; (4) depletion of ground-water supplies; and (5) development of sites suitable for water storage.

Unprecedented interest and activity in comprehensive river systems planning have resulted. These planning efforts promise several benefits compared with the traditional, single-purpose approach such as (1) effective programs involving more complete consideration of benefits and adverse effects; (2) better utilization and more efficient distribution of scarce water supplies among competing uses and areas, thus contributing to economic growth; (3) more profitable use of capital available for development; and (4) improved design and scheduling of projects.

USDA AND COOPERATIVE PROGRAM

Current investigations concern development of improved methods for river systems planning; participation in plan formulation for river basins and subbasins, including investigations to identify and evaluate economic needs for development in rural areas, and analyses of benefits and costs of development alternatives; and economic review of Federal agency reports on proposed water resource developments. Most of the studies are applied economic research. Research at field locations is cooperative with the Soil Conservation Service and the Forest Service and, in some instances, with State water resource agencies, the Corps of Engineers, the Public Health Service, and other public agencies. Survey activities of the Federal agencies are coordinated by the Water Resources Council.

River systems planning work of the Division is financed largely through watershed protection funds and is coordinated through the Water Resources Council. In most cases, ERS studies represent contributions to an interagency-interdepartment comprehensive study. In some cases, the Division is funded by transfer arrangements from other agencies to undertake specific studies.

Although similar in subject matter to work described in Area No. 9, survey activities reported in this area are more detailed than those reported in Area 9 and cover areas smaller than the major water resource regions for which "framework plans" are developed. Plans for subbasin areas are of such character that specific projects needed within the next 10-15 years are identified. Subbasin plans are expected to be consistent with the framework plans of water resource regions. Objectives and criteria are of such nature as to require improved and more complete analytical systems. Investigational efforts are focused, therefore, on the types of analyses that contribute to optimal choices in the planning process regarding the location, combination of purposes, scale of development, and scheduling.

Survey data and analyses for this area of work are prepared for use mainly by agencies cooperating in coordinated water resources planning and are available as joint reports prepared by the Soil Conservation Service, Forest Service, and ERS. Separate reference documents concerning ERS work are prepared and limited supplies are available for regional offices.

A total of 20.1 scientist man-years was devoted to this area of work during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

Wabash River (Indiana and Illinois). Projections of economic activity in the Wabash River Basin are being developed through refinements of the Ohio Basin framework study procedures. The overall demand for food and fiber will be developed for six subbasins in the Wabash based on more detailed cost and yield data now being prepared. A navigation scheme for the Wabash has been proposed. Its potential effect on agriculture is being studied through informal cooperation with the Purdue Agricultural Experiment Station. Studies in progress include analysis of the irrigation and drainage potential on agricultural land and the impact of flood protection on cropping patterns.

Grand River (Michigan). An economic base study for use in the Appendix to the basin report was completed during the year. Projections of rural domestic and livestock water use, farm income, and the economic potential for irrigation and drainage were made during the year. Income from farm sales is expected to more than double by the year 2020, with the greater proportion coming from sales of livestock and livestock products. An economic potential exists for about 250,000 additional acres of drained agricultural land by 1980. Irrigation potential is mainly in the production of fruit and vegetable crops which are expected to double in acreage by the year 2020 under the assumptions outlined in this study. Results of these studies and an application of the findings to the basin's agricultural water development needs are reported in the Agricultural Appendix to the Grand River Basin Comprehensive Study currently being prepared.

Big Muddy River (Illinois). Studies indicate that farm population and employment in agriculture will continue to decline. Acreage and production of soybeans will rise rapidly, but feed grain acreage and production is expected to drop. Livestock production also is expected to decrease. Large acreages of the less productive soils likely will not be needed for agricultural production. Detailed analysis of the economic potential of flood protection, drainage and irrigation are scheduled upon completion of framework studies for the Upper Mississippi Basin, of which the Big Muddy is a subbasin.

St. Joseph River (Indiana and Michigan). Agricultural projections to 1980 were completed and a draft report prepared for review. Although even smaller amounts of cropland are expected to be used by 1980, water resource development may be desirable due to expected improvement in efficiency of agricultural production. Beyond 1980, the relative share of regional production in the study area likely will decline as poorer quality soil is used to meet added demands for food and fiber. Water resource development would not be expected to reverse this trend.

Sabine River (Louisiana and Texas). Projections indicate that agriculture will continue to decline in relative importance to the economy of the area. Though high quality water is available, land quality is such that the trend to less intensive agricultural land use in the basin will continue. Agricultural activity in the area with and without water and related land resource development in the basin is being analyzed.

James River (Virginia). A completed analysis indicates limited opportunities and needs for water and related land development projects in the near future. Opportunities for project development were identified in 15 subbasins representing 18 percent of the study area; however, projects in 6 of these subbasins would be marginal.

Studies were initiated during the past year in the Arkansas (Kansas), Lower Rio Grande (Texas), Big Sioux (South Dakota), Niobrara and Nemaha Rivers (Nebraska). Current work in each of the basins consists of assembling descriptive information on the agricultural economy and developing data on productivity of agricultural resources. Cooperative Agreements with Kansas State University and Texas A&M University provide for studies of the economic impacts of droughts and institutional impediments to resource development in the Arkansas and Lower Rio Grande River Basins, respectively.

Central Lahontan Rivers (Nevada and California). A plan for economic analysis has been developed. Intensive economic analysis of agricultural and rural water problems will be initiated as sufficient physical data becomes available. Essential data, such as technical coefficients of water use by crops produced in different areas, are being developed by cooperating agencies and will be available in the near future.

White River and Yampa River Subbasins (Colorado). Investigations were completed on the land and water resources of the White River Basin in Colorado. The basin has a total area of approximately 3,808 square miles and a 1960 population of 5,560. There are about 35,000 acres each of irrigated cropland and dry farmland with a potential for increasing the irrigated acreage to about 52,000 acres. The basin has large untapped coal and oil-shale resources, which if developed are estimated to increase the population of the basin to as much as 204,000 people in 2020. Preliminary plans for study of the Dolores and San Juan Rivers in Colorado were also prepared.

Puget Sound Region (Washington). A draft of background material for the introduction of the Agricultural Appendix and preliminary projections of agricultural output, yields, employment, land use, and number of farms to 1980

were prepared. The projections indicate that output will increase by nearly 45 percent, number of farms will decrease by 35 percent, employment will decrease by 30 percent, and harvested cropland will remain approximately unchanged. Irrigated land should double by 1980.

Sevier River (Utah). Input-output data for a linear programming analysis of the Sevier River Basin were developed. The programming analysis will begin soon. A production function was developed for alfalfa, using multiple-regression techniques and survey data. Preliminary findings are that 70 percent of the variation in alfalfa production can be explained by the model. Several indices of water use were developed and tested in the study. Results indicate that use of the indices improves the reliability of the model for estimating the value of additional units of irrigation water in alfalfa production.

Upper Rio Grande River (New Mexico). Investigations concerned with the Chama-Otowi Subbasin and preparation of a report for this subbasin. Preliminary planning was completed for special study of recreation potentials in the Upper Rio Grande Basin.

Willamette River (Oregon). A review draft on agriculture and food processing in the Willamette Basin was completed for the economic base study. Assistance was received from Oregon State University, Bureau of Reclamation and Soil Conservation Service. Agricultural production was projected to increase by about 45 percent between 1960 and 1980. The largest percentage increases were projected for vegetables, fruits and nuts, beef, and eggs. Cropland use was projected to decline slightly. The number of farms may decrease 50 percent by 1980. Urban and industrial expansion is expected to absorb 115,000 additional acres by 1980. Additional cropland soils areas are available, thus cropland will not be limited before 1980. Food processing output is expected to increase but employment is expected to decline in the basin.

In addition to the draft of the agricultural economy for the Economic Base Study, a first draft of a manuscript on "Past and Possible Future Expansion in Urban Land Use" was prepared. In the latter study a regression method was used to relate density of settlement to size of urban area and the results used to project future needs for urban land under alternative population growth assumptions.

Arkansas River (Arkansas). Installation of the navigation project in this valley will alter the stream regimen to a considerable degree. Agricultural activities which have developed in the areas may be adversely affected by this change. The impact on the agricultural economy as well as the total economy may be far-reaching. On-going Federal agricultural assistance programs will also be affected. The study is conducted in two phases: Phase I involves intensive study of three sample areas of the Arkansas River Valley. Information on farm organization, management practices, and crop production were collected and analyzed. These sample areas are considered to be typical of the alluvial area in the valley, and information from these areas will be expanded to cover the total basin area. A summary report covering 1965

calendar year was prepared in cooperation with Soil Conservation Service, Forest Service, and Agricultural Research Service and made available to the Dallas Division, Corps of Engineers Office. Phase II will analyze the primary and secondary impacts on the agricultural economy of the navigation project.

Big Black, Pearl and Pascagoula Rivers (Mississippi). Seasonal flooding of large areas of highly productive land and urban developments is a major problem in these basins. High erodability of large areas of land resources and inadequate drainage, surface and subsurface, also are important problems. The development process, to date, has been uncoordinated.

Two separate activities are being carried on in these basins. In addition to USDA survey programs, the Division is cooperating with the Mobile and Vicksburg District Corps of Engineers in preparing historical summaries of agricultural activities in the area and developing projections of the agricultural economy. The Department survey is completed with the exception of plan formulation, which is near completion, and impact studies which will be undertaken as soon as data are available.

Reimbursable activities under the cooperative arrangement with the Corps of Engineers are essentially complete. Current and projected agricultural use of the resources in these basins were made available to the Corps for all three river basins. A water management analysis relating to economic magnitude of floodwater, drainage, and irrigation problems was prepared for the Big Black and Pascagoula River Basins. Work is currently underway to develop similar information for the Pearl River Basin.

Red River (Louisiana, Arkansas and Texas). Because of topographic characteristics, a large portion of the Red River downstream from Denison Dam cannot adequately discharge surplus water without installation of storage and drainage devices. The problem has been aggravated by inconsistent and piecemeal local, State, and Federal efforts which impede orderly and desired economic development. For example, navigation interests have for many years sought to expand inland channels which would complicate planning for basin-wide water resources development. The stream gradient compounds the difficulties of water development by fostering a high concentration of both organic and inorganic pollutants.

Agricultural economic activity in the basin has been identified for both the present and anticipated future time periods. These data include agricultural use of natural resources and changes indicated if the basin is to supply a prorata share of the national food and fiber production. Economic analysis of flood control, drainage, and irrigation were completed for the basin.

St. Johns River (Florida). This study was undertaken during FY 1966 in cooperation with the State of Florida. Competition for use of the land and water resources of this State is severe and efforts are being made to develop a water and related land use and development plan for the entire State. Expanding nonagricultural uses of water and related land are of major consideration in this activity. Deficiencies of these resources probably will exert great

influences on the future economic structure of the State. Secondary data on the agricultural economy of the St. Johns River Basin are being summarized and analyzed. Major emphasis is on the citrus and vegetable industries because of their significance in the basin.

South Grand-Osage River (Missouri). This work was initiated during FY 1966 and in cooperation with the State of Missouri. Economic considerations associated with the installation of Kaysinger Bluff Reservoir in the basin will be the major emphasis of this study. Underemployment and misallocation of resources have adversely affected economic development and water resources management potentials have not been fully exploited. The survey and planning analysis will draw upon data generated by the Missouri River Basin framework study (See Area 9).

Meramec River (Missouri). Urban encroachment into agricultural areas and expanding competition for water and land are significant problems in the basin. Resource development planning by local, State and Federal interests has been uncoordinated in the basin and there was a real need for an orderly plan of development which gives cognizance to a wide range of interests. The survey is now complete and included in the final survey report. Recreation research undertaken cooperatively with the University of Missouri in conjunction with the basin study also have been completed.

Poteau River (Oklahoma). Participation in this survey was limited due to lack of funds. Division personnel consulted with SCS basin staff and assisted in developing historical and projected information on agriculture in the basin.

West Coast Tributaries (Florida). Major activities of the survey were completed in previous years. A final report on this activity was prepared during the reporting period. The report, "Water and Related Land Resources, Florida West Coast Tributaries," was prepared by SCS, ERS, and FS.

White River (Missouri and Arkansas). Uncontrolled runoff from the higher elevations and the extremely flat topography of the delta portion of the basin constitutes the major obstacle to economic development. Sediment and erosion from large susceptible areas have reduced the water-carrying capacity of channels.

In addition to USDA responsibilities in the comprehensive basin survey, the Division, under an agreement with the Little Rock District Corps of Engineers Office, is developing agricultural data for the Economic Base Survey. Present and expected future economy and structure of agriculture were prepared as a part of the Economic Base Study and transmitted to the Corps of Engineers.

Susquehanna River Basin (Pennsylvania and Maryland). An economic base study for the Susquehanna River Basin has been completed with major efforts centered on a linear programming analysis. A report on this study is in draft form. Projections of rural population, agricultural production, agricultural employment, and similar agricultural factors are included in the report. The study also indicates an economic potential for about 60,000 acres of irrigation by 1985. Agricultural use of water for domestic purposes is expected to increase 180 percent by 1985.

Connecticut River Basin (Connecticut, Massachusetts, New Hampshire and Vermont) An agricultural study of the Connecticut River Basin provides for projections to the year 2020. Dairy production in the Connecticut River Basin is projected to increase gradually over the next 50 years. Production of fresh vegetables is projected to increase about 78 percent, while the production of all other crops and processed vegetables is expected to decline. Water requirements for rural domestic use are expected to double during the next 50 years.

Kanawha River Basin (West Virginia). An agricultural study of the Kanawha River Basin is in preliminary draft form. An attempt is being made to incorporate 1964 Census of Agriculture data. Between 1959 and 1964, nearly 16 percent of the farms in the Kanawha River Basin discontinued operations, while there was a decline of about 24 percent of land in farms. During this same period, there was only a slight decline in the value of farm products sold indicating a considerable increase in values of products sold per farm.

Stewart, Clyde E. 1966. The role of economics in river basin surveys. Proceedings, Eleventh Annual New Mexico Water Conference, pp. 83-94.

Summitt, William R. 1966. River basin investigation in New Mexico. Bureau of Business Research, University of New Mexico, Albuquerque, N. Mex.

AREA NO. 11. NATURAL RESOURCE MANAGEMENT FOR COMMUNITY DEVELOPMENT

Problem. This area of work is concerned primarily with providing technical assistance and conducting studies of economic feasibility and impacts as a part of the Resource Conservation and Development Program, authorized under provisions of the Food and Agriculture Act of 1962. An RC&D project is a locally initiated and sponsored activity. The objective of the program is, "to expand the economic opportunities for the people of an area by developing and carrying out a plan of action for the orderly conservation, improvement, development, and wise use of their natural resources."

USDA AND COOPERATIVE PROGRAM

The program of technical assistance and applied research is carried out in the following major areas: (1) Economic studies of project proposals which would have effects beyond the project area; (2) evaluation of economic impacts in selected project areas; and (3) staff assistance to the Soil Conservation Service in project review and technical assistance to local project sponsors. Program activities are undertaken in Washington, D.C. and in five field locations. The program of support is guided by annual work plans prepared under a Memorandum of Agreement with the Soil Conservation Service effected in 1964. Currently, 25 projects are authorized for planning or operations. Nearly all projects involve multicounty areas.

Informal cooperation has been established with Agricultural Experiment Stations and formal cooperation will be sought for specific studies.

A total of 3.1 scientist man-years was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Economic Studies of Proposed Project Measures

A study of the feasibility of alfalfa dehydrating facilities for two project areas in the Northwest was completed and published. This study analyzed the adequacy of the resource base, the potential markets, and the plant operations. The study indicated that the proposal should be recommended in one area but not in the other. The results have subsequently been used to evaluate similar proposals in Kentucky, Minnesota, and Mississippi.

A similar three-phase approach was used to evaluate the feasibility of processing and marketing wood shavings and sawdust in the West. This study indicated a very promising potential in many areas where sufficient raw materials are available. However, the low capital requirement required for entry could lead to unprofitable overproduction in a short time.

Analyses and technical assistance are being provided on various recreation proposals throughout the country. Evaluation of recreation enterprises was carried out in Georgia. Proposals for community development of recreation facilities around water impoundments are being studied in Vermont, Wisconsin, and Minnesota. A recreation survey is being planned for the New Mexico project area.

B. Evaluation of Economic Impacts

Work is underway on the evaluation of economic impacts in selected project areas and on the development of improved methodology for measuring impacts resulting from this broad resources development program. Several studies to test various approaches to measurement of economic impacts are underway. One study is assessing local economic impacts resulting from loss of a sugar beet processing plant in the Montana RC&D project area. The analysis includes evaluation of the alternatives available to farmers previously producing sugar beets and the measures which may be accomplished under the RC&D program to overcome the adverse effects of the plant shutdown.

The Crow Wing Canoe Trail in Minnesota has been promoted and operated for two years by local business leaders with sponsorship of the RC&D project. A study is underway in cooperation with the Minnesota Experiment Station to determine the impact on the local economy and to develop information useful to the local people in promoting its use.

Studies are being made in the Pennsylvania RC&D area of a vacation home subdivision around an artificial lake. Estimates will be made of the amount and timing of impacts on local business and employment, land values and tax base, and Government services required. Preliminary results indicate that the effect of the sales of the lots alone has resulted in an increase of assessed valuations of 80 percent and 15 percent in the two affected rural townships.

C. Program and Technical Assistance

Staff assistance includes technical review of RC&D project work plans and cooperating with SCS personnel in developing guidelines for reporting and evaluating project impacts in terms of income, employment, and nonmarket effects. During reporting period, assistance was also provided to project sponsors in 10 States. This included assembly and analysis of basic socio-economic data and recent trends, consultation with the sponsoring groups, and assistance in estimating probable impacts of proposed project measures on local incomes and employment.

A. Economic Studies of Proposed Project Measures

McArthur, J'Wayne, and Taylor, Gary C. 1966. Feasibility of establishing alfalfa dehydrating plants in northwest resource conservation and development project areas. U.S. Dept. of Agriculture. ERS-296. 14 pp.

McArthur, J'Wayne, and Warnick, Glenn. 1966. Economic potentials for baling wood shavings and sacking sawdust, four western resource conservation and development project areas. U.S. Dept. of Agriculture. ERS-

Line Project Check List--Reporting Year October 1, 1965 to September 30, 1966

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Project Incl. in Summary of Progress (Yes-No)	Line Project Incl. in Area and Subheading
NRE 1	Land Utilization			
NRE 1-1	National land use inventory	Washington, D.C.; West Lafayette, Ind.; and Dallas, Texas	Yes	1-A
NRE 1-2	Economic appraisal of land resource development in the United States	Washington D.C.; St. Paul, Minn.; Tucson, Ariz.; & Honolulu, Hawaii	Yes	1-B
NRE 1-3	An economic appraisal of the Federal agricultural land purchase and development program of the 1930's*	Washington, D.C.	No	
NRE 2	Water Use and Management			
NRE 2-1	Economic appraisal of agricultural water use and supply**	Washington, D.C.	Yes	2-A
NRE 2-2	Improved method for the economic evaluation of land and water resource development projects and programs***	Washington, D.C.	No	
NRE 2-3	Economic appraisal of humid-area irrigation trends, potentials, and water values	Washington, D.C. & Madison, Wis.	Yes	2-A
NRE 2-4	Economics of watershed managment**	Washington, D.C.	Yes	2-C
NRE 2-5	Economics of land forming for water management in selected Eastern States*	Washington, D.C. & Madison, Wis.	Yes	2-B
RDE 2-6	Economic appraisal of irrigation conveyance systems in California***	Washington, D.C.	No	
NRE 2-9	Values of water for irrigation in the Willamette Valley**	Corvallis, Oregon	Yes	2-A
NRE 3	Legal-Economic Aspects of Land and Water Use			
NRE 3-1	Legal aspects of water rights in the West	Berkeley, Calif.	Yes	3-A
NRE 3-2	Legal aspects of water rights in the East	Madison, Wis.; Oxford, Miss.; & Gainesville, Fla.	Yes	3-A
NRE 3-3	Analysis of rural zoning enabling statutes and ordinances	Washington, D.C.	Yes	3-B
NRE 3-4	Economic appraisal of local resource organizations	Washington, D.C. & St. Paul, Minn.	Yes	3-C
NRE 3-5	Analysis of the feasibility of easements and protective covenants for guiding rural land use		No	

*Terminated during reporting year.
**Projects terminating but to be revised or extended.
***Project expired and to be terminated.

Line Project Check List--Reporting Year October 1, 1965 to September 30, 1966

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Project Incl. in Summary of Progress (Yes-No)	Line Project Incl. in Area and Subheading
NRE 4	Land Tenure			
NRE 4-1	Development and analysis of basic farm tenure information	Washington, D.C. & East Lansing, Mich.	Yes	4-A
NRE 4-2	Appraisal of economic aspects of land tenure laws	Iowa City, Iowa & Ft. Collins, Colo.	Yes	4-B
NRE 4-3	Maintenance of information on farm leases	Washington, D.C.	No	
NRE 4-5	Public-private arrangements for the control and use of resources in the Western States	Ft. Collins, Colo.	Yes	4-B
NRE 4-7	Analysis of land tenure problems and policies of Puerto Rico*	Ft. Collins, Colo.	Yes	4-C
NRE 5	Impact of Urban Growth on Rural Areas			
NRE 5-1 (Rev.)	Economic appraisal of impacts of urban growth on rural land use	Washington, D.C.	Yes	5-B
NRE 5-2	The economics of outdoor recreation as a use of rural land	Washington, D.C.; Atlanta, Ga.; Madison, Wis.; & Ann Arbor, Mich.	Yes	5-A
NRE 6	Resource Income Distribution			
NRE 6-1	Analysis of the Great Plains Conservation Program	Washington, D.C. & Ft. Collins, Colo.	Yes	6-B
NRE 6-2	Analyses of trends in land and other resource income	Washington, D.C. & Ames, Iowa	Yes	6-A
NRE 6-3	Incidences of benefits and costs of land use controls and tenure institutions in the North Central Piedmont	Washington, D.C.	Yes	6-B
NRE 6-4	Effects of tenure institutions and government programs upon resource income distribution in the Central Great Plains	Ft. Collins, Colo.	Yes	6-B
NRE 6-5	Analysis of income distributional effects of alternative public programs in Southwestern States	Baton Rouge, La.	Yes	6-B
NRE 6-6	Identifying and measuring effects of technical, institutional, and economic forces upon farm resource income distribution	Washington, D.C. & St. Paul, Minn.	Yes	6-A
(NRE 7)	Quality of Natural Resources (in preparation)	Washington, D.C. & Ann Arbor, Mich.	Yes	7

*Terminated during reporting year.